U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS.

INSTRUCTIONS TO FIELD PARTIES

AND

DESCRIPTIONS OF SOIL TYPES.

FIELD SEASON, 1902.

19722—02——1

U. S. Department of Agriculture,
Bureau of Soils,
Washington, D. C., March 7, 1902.

The accompanying instructions to field parties of the Bureau of Soils have been prepared for the use of field men to facilitate the preparation and auditing of accounts. The material on fiscal regulations is in addition to the Fiscal Regulations as issued by the Division of Accounts and Disbursements and should be taken as supplementary to these Department Regulations. All field men should be careful that all accounts conform strictly to these regulations.

The Descriptions of Soil Types are given as an aid to the field parties in correlation of soil types and should be carefully studied to this end. Wherever a new type is found the previously described types should be consulted and the new type correlated with a known type where this is possible.

Milton Whitney,
Chief of Bureau.

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INSTRUCTIONS TO FIELD PARTIES.

Fiscal regulations.—The pamphlet on "Fiscal Regulations of the Department of Agriculture" issued by the Division of Accounts and Disbursements applies to all fiscal matters of this Bureau, with certain modifications and additions given below. Field agents of this Bureau should carefully read the regulations and conform literally to the instructions given there. Monthly accounts are frequently delayed in payment because of the failure of conforming to the rules of the Department. Hereafter no attempt will be made to supply information lacking on vouchers or subvouchers, but the accounts will be returned for correction. Delays of this character can be entirely avoided if field men are careful to have all accounts conform literally to instructions given in the Fiscal Regulations and to make explanation of all items of expenditure on the subvouchers. All expenses not accompanied by subvouchers (subvouchers must be submitted for purchases amounting to $1 or more) should be fully explained in a memorandum attached to voucher. Charges for lodging and team hire must always be supported by subvoucher.

Duplicate vouchers on Form 4, with subvouchers (Forms 4a, 4b, 4c) are to be submitted promptly at the end of each month, properly filled out, and signed before notary. The receipt and oath should be signed on each voucher in all cases, but the notary's signature and seal should be on but one voucher. Every voucher for reimbursement of traveling expenses must be accompanied by Form 4c showing what portion of the travel has been performed on transportation requests. When no requests have been used a blank form properly signed should be filed with the voucher, and a statement made on this form showing that no transportation requests were used.

Authorization to travel.—An authorization from the Chief of the Bureau of Soils must be obtained before any travel is performed for the Department, and written or telegraphic authorization must be obtained for all travel outside of an area or where unusual expense or additional travel is necessary.

Transportation.—Travel to and from areas should be performed on transportation requests where the cost of travel amounts to $3 or more. (See Fiscal Regulations, par. 15, etc.) West of the Mississippi River all travel should be performed on transportation requests. Transportation requests will be furnished on application to the chief clerk of the Bureau. Applications for these requests should be made at least one week before the travel is to be performed. In filling out transportation requests, before presenting to ticket agent, be sure to fill in all blanks upon the face of the request. The stub on end of request is to be filled out when the request is issued and returned at once to the Bureau of Soils.

Freight and express.—When express charges are included in an expense account, the original express receipt must be attached to the subvoucher. Express charges to Washington, D. C., should not be prepaid, but the shipments should be made collect.

When possible, shipments should be made by freight rather than by express. Shipments by freight from points west of the Mississippi River should be made according to paragraph 14, Fiscal Regulations. The property to be sent should be securely packed, and notice should be given to the Chief of the Bureau, fully describing the property and giving the full name and address on the package, with the name of the person in whose care the property is stored.

Allowances for field parties.—While engaged in actual travel the limits of expense should be governed by the Fiscal Regulations (par. 12g). While in an area engaged in field work not more than $1.50 per day per man on an average is to be paid for subsistence; when possible, cheaper rates should be secured.

The usual rate for hire of horse and buggy is $1.50 per day. This rate should not be exceeded except where actually necessary. If it is found that proper conveyances can not be secured in an area at this price the fact must be made known to the Chief of the Bureau at once.

When the party remains at one place for a period of more than one week, cheaper rates by the week can nearly always be secured. Advantage should be taken of such weekly rates. When boarding at reduced rates it sometimes happens that the party is away from the regular boarding place for one or more meals, or perhaps an entire day. The Fiscal Regulations explicitly state that subsistence expenses can not be allowed at more than one place, but it has been ruled that when reduced rates are being paid subsistence expenses will be allowed for short periods away from the regular boarding place, provided the extra expense plus the reduced rate does not exceed the week rate calculated at the regular day rate. Thus, if a party is living at a hotel or boarding house the regular rates of which are $2 per day, and by reason of staying for one week or longer a rate of $1.50 per

day is secured, and it should happen that the party could not get back to the hotel, but took meals or lodging away (paying for the meals or lodging), the cost of these would be allowed, provided the entire week's expenses did not amount to more than $14. Duplicate charges of this character are allowed only in the interest of economy, and should not be incurred except when absolutely necessary. Where such duplicate charges are made a full explanation must be made satisfactory to the Chief of the Bureau and the disbursing officer.

Subvouchers for team hire.—The following form shows a subvoucher for team hire completely filled out. All such subvouchers should describe rig, state dates used and number of hours in use, give distance traveled and use to which team was put. In case a team is used on Sunday or a holiday, the reason for using it should be stated.

Form No. 4*b*. Subvoucher No. 1.

$7.50. City or town, COLUMBUS, OHIO,
Date, *Dec. 27, 1901.*

Received of John Smith, U. S. Department of Agriculture, Seven and $\frac{50}{100}$ dollars.

For hire of horse and buggy for use in soil mapping Dec. 23, 24, 25, 26 and 27, 5 days at $1.50 per day 7.50
In use 8 hours per day. Average distance traveled 20 miles.

Team used on Dec. 25 was on official business.

(Signature) JAMES SCOTT,
(Title) *Owner of team.*

Signatures to subvouchers.—Paragraph 35 of the Fiscal Regulations contains explicit instructions regarding the signatures to subvouchers. Care should be taken that all signatures conform to these instructions. All signatures must be written in ink. The name of the person signing the receipt must appear upon the receipt, and the authority for signing must appear in the title, which must be written by the signer below his name. Where a subvoucher is signed by mark, one disinterested witness should sign the subvoucher and give his address. When a firm name or a hotel name is signed to a subvoucher, the full name and title of the person receiving the money must also be given.

Laundry.—With regard to the item of laundry in expense accounts where parties are located for any length of time at a particular point, it is usually possible to make arrangements by which laundry may be done at a fixed price, usually about 50 cents per week per person, and wherever this is practicable it should be done. It will, however, happen that parties who are traveling or are moving their headquarters frequently will be unable to make arrangements of this kind, and in such cases the expense for laundry will necessarily exceed this amount; in no case, however, must the charge for laundry exceed $4 per person per month, and expense accounts containing charges in excess of this amount will be corrected.

Telegrams.—Telegrams sent at Government rates should refer only to official business. The Treasury Department has ruled, however,

that chiefs of parties who are responsible for the accounts of the party may telegraph in regard to salary checks or expense-account checks which have been delayed, when the money is needed for use in defraying the expenses of the party. Such telegrams, however, should not be sent except when the delayed check has been awaited a reasonable time. Telegrams regarding leave should not be sent at Government rates or charged to the Department.

The Chief of the Bureau should be informed by telegraph of every change in address of the party in the field. In sending telegrams to the Bureau, address to "Soils, Washington, D. C.," and sign the telegrams by last name only.

Location of headquarters while in field.—The attention of the assistants of the Bureau of Soils is directed to the advisability and real necessity of keeping as near as possible to their field of operations. In no case where it can be avoided should a man be located at a greater distance than 6 miles from the area to be surveyed, as 12 miles distance there and back, added to the day's work, is a material hardship on the team, and reduces considerably the amount of work that can be done in the course of the day.

For the most part the field work of the Bureau is carried on in well-settled districts, where it should be possible to obtain board and lodging for a few days at least in farm houses, provided there are no hotels or lodging houses convenient to the area to be surveyed.

There is no objection to obtaining rates by the week, and this is advisable where the place is conveniently located for the work, and will be found cheaper than paying by the day, but no longer term should be provided for, except in certain circumstances, as in most cases a field party should be able to survey a sufficient area in one or two weeks to warrant a removal to some more convenient place. It happens at times, however, that for lack of accommodations a longer time than this has to be spent in one locality or else a camp outfit be provided. This latter contingency has not yet been considered in connection with the work of the Bureau. The Fiscal Regulations of the Department (paragraph 12 g) provide that board and lodging can only be paid for a period not to exceed thirty days in any one locality, and this regulation holds against the field assistants in this Bureau, except that where suitable accommodations can not be obtained and camp outfits are not provided, the Secretary of Agriculture (in letter of authorization No. 4098) has empowered the Chief of the Bureau to grant an extension of time in which board and lodging will be allowed in any one locality to sixty days or to any shorter term within his discretion.

When from any cause it is considered necessary or advisable to remain in one place for a period exceeding thirty days, the Chief of the Bureau must be notified and satisfactory reasons given him why

the party should remain longer than thirty days, and if in his judgment the reasons are sufficient, the length of time will be extended and the disbursing office notified of the fact, so that the accounts will be passed in that office. Such action must be taken specifically for each case, and the request for an extension of time must be mailed a sufficient length of time in advance to allow of action being taken. Otherwise in no case will the board and lodging be allowed in any one locality for a period exceeding thirty days.

Accidents to parties.—The following general instructions are issued for the guidance of field men of the Bureau of Soils, in the event of possible accidents to teams or vehicles that may be hired by them for official use in the field.

Should an accident occur which results in any damage to a horse or vehicle under your care, and if such accident is due to carelessness or fault on your part, or that of your assistants, it will be considered a personal responsibility of your own and you will be expected to make the necessary settlement with the owner. The settlement will devolve upon you in the event of the accident being due to fast or reckless driving, excessive use, or in any other case in which you can not show that proper judgment and care and reasonable precautions have been used.

If an accident should be due to causes for which you are not responsible, it might constitute a claim against the Government, and if such claim was approved by the Department, the matter would be referred to Congress for an appropriation to reimburse the owner. In such cases you are cautioned *not to pay the claim*, but to refer the matter to this Department; payment of such claim by you would constitute prima facie evidence that the accident was due to carelessness on your part, and the matter could not then be handled by the Department. Should the horse be taken sick, or if an unforeseen and unavoidable accident should occur to either horse or vehicle while in the employ of the Department, claim should be made, accompanied by affidavits, properly sworn to, setting forth all the facts of the case and substantiated in every possible way by disinterested witnesses.

The greatest care is enjoined upon all representatives of the Bureau in the care of teams and in their safe delivery to owners after use.

Settlement of claims of this kind through Congress are very troublesome and tedious, and they should not be presented to the Department if it is possible to avoid it, and then not unless it involves considerable money and is accompanied by strong and irrefutable evidence that the Department agent is not responsible. Such claims will be scrutinized very carefully before being acted upon by this Department.

Six-months reports.—On the 1st of July and 1st of January of each year a report upon Form No. 41 of this Bureau should be made out by each assistant in charge of party and forwarded to the Chief of the

Bureau. This report shows the area surveyed in each district, the cost per square mile, and the actual time given to the survey. In order that assistants may make out this report, memorandums should be kept of all expenses. In calculating cost of work include salaries, subsistence while in the area, and team hire with any necessary miscellaneous expenses. Transportation expenses (which include railroad fare, sleeping-car fare, meals en route, etc.) should not be included in calculating cost per square mile. The salary should also only be calculated for the time actually spent in the area.

Organization of field party.—A field party in the soil survey usually consists of two men—an assistant in charge of party and a field assistant. The assistant in charge of party shall control all field work of the party, prepare the report and maps, carry on all correspondence necessary to the conduct of the survey, pay all field expenses of the party, and forward monthly expense accounts to the office of the Bureau in Washington. The field assistant shall perform all duties required of him by the assistant in charge.

Outfit for work.—The outfit for field work consists of the following:

Soil auger, 40-inch handle.
Geologist's hammer.
Note books.
Compass or plane-table.
Odometer.
Chain scale.
Set of colored pencils.
Base map.
Sacks and tags for collecting samples of soil.
Cards for reporting samples collected (Forms 46, 47, 48).

In addition to the above certain parties should add:

Alkali outfit.
Extension auger and pipe wrenches.
Filter pump.
Metallic tape 50 feet long.

These supplies are to be obtained on application to the property clerk of the Bureau, countersigned by the chief clerk. Memorandum receipts are taken by him for all supplies issued. Additional supplies, stationery, etc., needed while in the field are to be ordered on card, Form 43. The loss of, or damage to, any supplies should be at once reported to the chief clerk, with an explanation of the cause of such loss or damage.

Prosecution of field work.—All mapping should be on a scale of 1 inch to 1 mile. Where possible base maps on this scale will be furnished all field parties before entering the field. Wherever such maps are supplied it is supposed that they are the most reliable and complete

maps obtainable. Field parties should endeavor to correct the base map if it is found in error. Frequent check upon directions should be made with the compass, and all distances on roads are to be measured with the odometer. Where from the nature of the error it is found impossible to make correction, the soil map should conform to the base used, but careful note should be made of all such errors, so that in case a revised edition of the map is published the correction can be made without a resurvey of the soils.

Odometer.—The Bell odometer has been adopted for use in all measurements. The instrument should be clamped to the axle of the vehicle by the band which supports the shafts. The iron pin is driven in the end of the hub and is bent so that as the wheel revolves the end of the pin strikes just the swell of the cogwheel on the odometer. If the instrument is carefully adjusted very little trouble is experienced in its use. The red hand revolves once every mile, giving the fractions of a mile, each space representing one-fortieth of a mile, or 8 rods. Each revolution of the red hand moves the yellow hand one space, representing the miles up to 40 in one revolution around the dial, and shown by the inside figures. Each revolution of the yellow hand moves the black hand one space, each space representing 40 miles, and shown by the outside figures. The sum of the indications of the three hands gives the mileage. Each odometer is adapted to but one sized wheel. In case it is impossible to obtain a vehicle with a wheel of the proper size for the odometer you have, the readings must be corrected in order to read miles. Should any other sized wheel be used, the following formula will enable the proper correction to be made:

$$x = \frac{a\,d}{d_1}$$

Where x is distance traversed in fortieths of a mile, d is the diameter of the wheel to be used, d_1 is the diameter of wheel to which the odometer is adapted, and a is number of dial divisions as read from odometer.

The instruments furnished by this Bureau are nearly all adapted to a 42-inch wheel. The following table will enable the proper correction to be made when any other than a 42-inch wheel is used. The figures in the first column are the dial divisions as read from the odometer, and the figures in the other columns give the distance traveled in fortieths of a mile. Chain scales divided into 40 parts to an inch are supplied for convenience in platting distances as measured or calculated in this table.

Table for reducing odometer readings to fortieths of a mile.

Dial divisions.	Wheel diameter.							
	38 inches.	39 inches.	40 inches.	41 inches.	43 inches.	44 inches.	45 inches.	46 inches.
1	0.9	0.9	1.0	1.0	1.0	1.0	1.1	1.1
2	1.8	1.9	1.9	2.0	2.0	2.1	2.1	2.2
3	2.7	2.8	2.9	2.9	3.1	3.1	3.2	3.3
4	3.6	3.7	3.8	3.9	4.1	4.2	4.3	4.4
5	4.5	4.6	4.8	4.9	5.1	5.2	5.4	5.5
6	5.4	5.6	5.7	5.9	6.1	6.3	6.4	6.6
7	6.3	6.5	6.7	6.8	7.1	7.3	7.5	7.7
8	7.2	7.4	7.6	7.8	8.2	8.4	8.6	8.8
9	8.1	8.4	8.6	8.8	9.2	9.4	9.6	9.9
10	9.0	9.3	9.5	9.8	10.2	10.5	10.7	11.0
11	9.9	10.2	10.5	10.7	11.3	11.5	11.8	12.0
12	10.8	11.1	11.4	11.7	12.3	12.6	12.8	13.2
13	11.7	12.1	12.4	12.7	13.3	13.6	13.9	14.2
14	12.6	13.0	13.3	13.7	14.3	14.7	15.0	15.3
15	13.5	13.9	14.3	14.6	15.3	15.7	16.1	16.4
16	14.4	14.8	15.2	15.6	16.4	16.8	17.1	17.5
17	15.3	15.8	16.2	16.6	17.4	17.8	18.2	18.6
18	16.3	16.7	17.1	17.6	18.4	18.8	19.3	19.7
19	17.2	17.6	18.1	18.5	19.4	19.9	20.3	20.8
20	18.1	18.6	19.1	19.5	20.5	20.9	21.4	21.9
21	19.0	19.5	20.0	20.5	21.5	22.0	22.5	23.0
22	19.9	20.4	20.9	21.4	22.5	23.0	23.5	24.1
23	20.8	21.3	21.9	22.4	23.5	24.1	24.6	25.2
24	21.7	22.3	22.8	23.4	24.5	25.1	25.7	26.3
25	22.6	23.2	23.8	24.4	25.6	26.2	26.8	27.4
26	23.5	24.1	24.7	25.4	26.6	27.2	27.8	28.5
27	24.4	25.1	25.7	26.4	27.6	28.3	28.9	29.6
28	25.3	26.0	26.6	27.3	28.6	29.3	30.0	30.7
29	26.2	26.9	27.6	28.3	29.7	30.4	31.1	31.8
30	27.1	27.8	28.6	29.3	30.7	31.4	32.1	32.9
31	28.0	28.8	29.5	30.3	31.7	32.5	33.2	33.9
32	28.9	29.7	30.4	31.2	32.7	33.5	34.3	35.0
33	29.8	30.6	31.4	32.2	33.8	34.6	35.3	36.1
34	30.7	31.6	32.4	33.2	34.8	35.6	36.4	37.2
35	31.6	32.5	33.3	34.2	35.8	36.6	37.5	38.3
36	32.5	33.4	34.3	35.1	36.8	37.7	38.6	39.4
37	33.4	34.3	35.2	36.1	37.9	38.7	39.6	40.5
38	34.4	35.3	36.2	37.1	38.9	39.8	40.7	41.6
39	35.3	36.2	37.1	38.1	39.9	40.8	41.8	42.7
40	36.2	37.1	38.1	39.0	40.9	41.9	42.8	43.8
41	37.1	38.0	39.0	40.0	41.9	42.9	43.9	44.9
42	38.0	39.0	40.0	41.0	43.0	44.0	45.0	46.0
43	38.9	39.9	40.9	42.0	44.0	45.0	46.1	47.1
44	39.8	40.8	41.9	42.9	45.0	46.1	47.1	48.2
45	40.7	41.8	42.8	43.9	46.0	47.1	48.2	49.3

Plane-table traversing.—It is sometimes impossible to furnish the field party with a base map of proper accuracy. In all such cases the party will be supplied with a plane-table outfit, and a traverse base

map of the area is to be constructed in the field by the soil-survey party. This traverse work should, however, be reduced to a minimum by all soil-survey parties, for where the amount of traverse work is likely to be large or difficult a traverse party will go ahead of the soil party and prepare the base map.

In carrying on traverse work or surveying of any description, the methods used, where possible, should conform to well-established methods, such as are given in Wilson's Topographic Surveying.

Establishing soil types.—At the end of this pamphlet is given a concise description of all of the types of soil described by this Bureau up to December 31, 1901. In establishing types in an area this list should be carefully consulted, and where possible all types are to be correlated with types there described. As soon as a type is determined upon, whether new or previously described, a description of it should be sent to the Bureau on Form 46. The selection of a provisional name for each soil type should be made, and in all correspondence and reports this name should be used when speaking of the type.

In the humid portions of the country the description of a soil type is to extend to a depth of 3 feet, and in the semiarid and arid regions to a depth of 6 feet. In speaking of a type the material to these depths is meant, not the surface soil alone.

Samples for laboratory examination.—To avoid unnecessary work and to prevent overcrowding of the laboratory force, it will be very necessary to use care and judgment in the selection of samples for mechanical or chemical examination.

Soil samples, as a rule, should not be collected until the party has obtained a very thorough acquaintance with the type conditions; then a description of the soil type should be sent in upon Form 46. This description should be of so general a nature that it will apply to all samples collected from that soil in that district. Then, too, this type description should be made of every soil type found in the district, whether it is a correlation of the soils occurring in other districts or a new type.

After this general description has been sent in a limited number of samples from not exceeding four places in each soil type, and limited to one or two localities in the case of less important types, should be collected and the individual samples described on Form 47, one card being used for each sample, whether it is of a soil or subsoil, and each sample being designated by the local name adopted for the type to which it belongs.

It will be better to defer taking samples until the work has progressed sufficiently far to insure a thoroughly representative set of samples.

A separate card (Form 48) is provided for miscellaneous samples, such as marl, minerals, crusts, and plants, and in all cases such samples

should be fully described, and the kind and purpose of the examination desired should be clearly stated. Often a qualitative examination will answer if we know the purpose of the work, and thus the long and tedious process of a complete chemical analysis may often be avoided.

Care in attending to these details will insure the greatest accuracy, and the earliest completion of the work; so that the results may be available as soon as possible, preferably before the party leaves the district.

Write all cards and tags on samples of soil in ink, as pencil rubs badly and is sometimes illegible when received in the office.

Correspondence and weekly report.—All correspondence with the Bureau should be addressed to the Chief of the Bureau. At least once each week the head of the party should report to the Chief by letter, informing him of the progress of the work, the results which have been attained, describing new types of soil, and giving a statement of the health of members of the party.

At the end of each week a report on card, Form 49, should be filled out and returned to this office. This card report is not to take the place of a weekly letter, but should be accompanied by a letter giving in detail the operations of the party. The cards will be filed in the office for ready reference.

Field and office maps.—As fast as the soil maps are completed copies should be sent to the Chief of the Bureau to be filed. To facilitate this two copies of the base map are to be made. One copy should be cut into sections not more than 5 by 7 inches in size. As soon as the soils have been surveyed on a section an exact copy should be made and forwarded to the office. With each section should be sent a legend and a profile of each soil type. On the completion of an area or sheet all field maps with complete legend and profile and all notebooks, plane-table sheets, or data collected are to be forwarded by registered mail.

Directions for mapping alkali soils.—The contour intervals for the alkali maps are to represent, respectively, 0.20, 0.40, 0.60, 1, and 3 per cent of salt in the dry soil. The maps are to be constructed in the field directly from the resistances. The work is to be standardized in each district in the following way: Take eight or ten crusts, including the top inch of soil, or if crusts can not be obtained, take the strongest alkali soils from different places over the whole area. Fill a large cup, tumbler, or bottle about one-third full with a crust or soil, using more or less, according to the richness of the material, and nearly fill the receptacle with distilled water. Stir or shake vigorously several times and filter off a pint of the solution, using the filter pump. Rinse out the filter pump after each sample. Treat the eight or ten crusts or soils in the same way. The presence of black alkali will frequently give the solutions a reddish color, but this can be

ignored. Determine the electrical resistances of the solutions in the cell. Take an amount of the strongest solution equivalent to approximately 200 c. c. having a resistance of about 5 ohms, and add to it a volume of each of the others proportional to the resistances determined. If the resistance of this mixture, containing approximately equal quantities of salts from the eight or ten localities, is 10 ohms or less it can be used directly for the standardization. If the resistance is greater than 10 ohms, the solution should be evaporated until the resistance is sufficiently low. Carefully measure out 100 c. c. of this composite solution and transfer it to a small dish which has been carefully cleaned, dried, and accurately weighed to centigrams. Evaporate to dryness, ignite very gently to free the sulphates and carbonates of water of crystallization, let cool, and again weigh. The gain in weight will give the percentage of salts in the composite solution. This percentage divided into any percentage in the following table multiplied by 100 will give the number of cubic centimeters of the composite solution required to be diluted to 100 c. c. in order to contain the required percentage in the table. If the volume thus secured for some of the higher concentrations exceeds 100 c. c., it should be reduced to 100 c. c. by evaporation. Ordinarily a $3\frac{1}{3}$ per cent solution is as concentrated as will be required, as this represents 1 per cent of salt in the soil. The electrical resistance of this $3\frac{1}{3}$ per cent solution in any cell, divided by 0.24, will equal the resistance of sand or sandy loam in the same cell when completely saturated, and at a temperature of 60° F., when the soil contains 1 per cent of salt. The composite solution is to be diluted and the resistance determined at the various concentrations, corresponding to the limiting values of the alkali map for four grades of soil.

The dilutions are as follows, the figures representing the percentage concentration to which the solution is to be reduced:

To obtain limiting values.

Salt in soil.	Salt in solution.			
	s. and ssc.	sc.	scc.	c. and hc.
Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
3.00	10.00	7.95	7.14	6.67
1.00	3.33	2.65	2.38	2.22
.60	2.00	1.59	1.43	1.33
.40	1.33	1.06	.95	.89
.20	.67	.53	.48	.44
Resistances to be reduced to 60° F. and divided by	.24	.275	.29	.30

NOTE.—S. and ssc., sand and sandy loam; sc., loam; scc., clay loam; c. and hc., clay and heavy clay soil.

The result will give the cell resistance, when filled with saturated soil, at 60° F., corresponding to the limiting values to be inserted in the following table:

Table of limiting values.

Salt in soil.	s. and ssc.	sc.	scc.	c. and hc.
Per cent.	*Ohms.*	*Ohms.*	*Ohms.*	*Ohms.*
3.00	.....	.....	.....	.....
1.00	.....	.....	.....	.....
.60	.....	.....	.....	.....
.40	.....	.....	.....	.....
.20	.....	.....	.....	.....

NOTE.—If it is desirable to determine the 3 per cent limit in the soil, portions of the composite solution will have to be concentrated by evaporation according to the above directions so as to contain the percentage of salt given in the table. The cell filled with such concentrated solutions gives a resistance too low to be read on the instrument, and it will be necessary to take a measured amount of the solution in the cell, as, for example, one-quarter or one-fifth its capacity. Determine the resistance and divide it by 4 or 5, as the case may be. This gives the resistance of the cell when filled. For these concentrated solutions the readings will be rather indefinite. Keep the cell electrodes well cleaned at all times.

The irrigation water, or the soil, the electrical resistance of which is to be found, is put into the hard-rubber cell with metal electrodes. If the salt content of water is to be determined, the cell is filled even full with the water. If the salt content of soils is to be determined, the soil is made into the condition of a thin mortar with distilled water and the cell filled with this material, gently tapping the cell on the ground to exclude air bubbles. The top of the soil is then struck off with a knife edge so that the cell shall be just level full of the saturated soil. The cell is then suspended in the mercury cups attached to the electrolytic bridge and the electrical resistance determined in the following way:

The telephone receiver is pressed against the ear and the handle of the instrument pressed down, when a buzzing sound will be heard in the receiver. Holding the handle down so as to keep the battery switch closed, the pointer is rotated to either right or left until the position is found at which the note in the telephone receiver is no longer heard or is only indistinctly heard. On rotating the pointer to either side of this position, the sound in the receiver should gradually increase. In case difficulty is found in locating the exact position of balance, it will be found of assistance to rotate the pointer rapidly back and forth over the position of least sound, locating points of equal intensity on either side. The mean position between these two points gives the position of balance, and the number opposite the pointer gives the desired reading.

In case a balance is not obtained with the 1,000-ohm coil of the rotary switch, the 100-ohm and 10-ohm coils should be tried in succession. It is best to choose the coil which will bring the balance as near as possible to the center of the scale, as this is the most sensitive position.

Having obtained the balance, the resistance is found by multiplying the resistance of the comparison coil, as shown by the rotating switch, by the number on the scale opposite the pointer. Thus, if the comparison coil used has a resistance of 100 ohms and the reading on the scale is 0.92, the resistance in the scale is 92 ohms. If the comparison coil is 1,000 ohms and the reading on the scale is 4.5, the resistance would be 4,500 ohms. After taking the resistance in this manner, take the temperature immediately, either of the water or of the saturated soil, by sticking the bulb of a thermometer in and leaving it for some moments. The resistance is then corrected for this temperature according to the following directions:

Reduction of resistances to a temperature of 60° F.—A single illustration will serve to show the way the following table is used in the reduction of electrical resistances to a uniform temperature of 60° F.: Suppose the observed resistance of the soil is 2,585 ohms at a temperature of 50.5°. In the table at the temperature of 50.5°, as indicated on the left-hand side, we find that at that temperature 2,000 ohms is equal to 1,748 ohms at 60°; 5,000 ohms is equal to 4,370 ohms at 60°; hence, 500 ohms would be equal to 437 ohms. Similarly, 80 ohms would be one-hundredth of the value given for 8,000 ohms at 50.5° in the table, therefore equal to about 70 ohms at 60°, while the 5 ohms would be equal to about 4 ohms. These separate values are added together thus:

2,000	1,748
500	437
80	70
5	4
2,585 ohms at 50.5°	=2,259 ohms at 60°.

Reduction of the electrical resistance of soils to a uniform temperature of 60° F.

°F.	1000	2000	3000	4000	5000	6000	7000	8000	9000
32.0	625	1,250	1,875	2,500	3,125	3,750	4,375	5,000	5,625
32.5	632	1,265	1,897	2,530	3,163	3,795	4,425	5,059	5,691
33.0	640	1,280	1,920	2,560	3,200	3,840	4,480	5,120	5,760
33.5	647	1,294	1,941	2,588	3,235	3,883	4,530	5,177	5,824
34.0	653	1,306	1,959	2,612	3,265	3,918	4,571	5,224	5,877
34.5	660	1,320	1,980	2,640	3,300	3,960	4,620	5,280	5,940
35.0	668	1,336	2,004	2,672	3,340	4,008	4,676	5,344	6,012
35.5	675	1,350	2,025	2,700	3,375	4,050	4,725	5,400	6,075
36.0	683	1,366	2,049	2,732	3,415	4,098	4,781	5,464	6,147
36.5	690	1,380	2,070	2,760	3,450	4,140	4,830	5,520	6,210
37.0	698	1,396	2,094	2,792	3,490	4,188	4,886	5,584	6,282
37.5	704	1,408	2,112	2,816	3,520	4,224	4,928	5,632	6,336
38.0	711	1,422	2,133	2,844	3,555	4,266	4,977	5,688	6,399
38.5	717	1,434	2,151	2,868	3,585	4,302	5,019	5,736	6,453
39.0	723	1,446	2,169	2,892	3,615	4,338	5,061	5,784	6,507
39.5	729	1,458	2,187	2,916	3,645	4,374	5,103	5,832	6,561
40.0	735	1,470	2,205	2,940	3,675	4,410	5,145	5,880	6,615
40.5	742	1,484	2,226	2,968	3,710	4,452	5,194	5,936	6,678
41.0	750	1,500	2,250	3,000	3,750	4,500	5,250	6,000	6,750
41.5	757	1,514	2,271	3,028	3,785	4,542	5,299	6,056	6,813

Reduction of the electrical resistance of soils, etc.—Continued.

°F.	1000	2000	3000	4000	5000	6000	7000	8000	9000
42.0	763	1,526	2,289	3,052	3,815	4,578	5,341	6,104	6,867
42.5	770	1,540	2,310	3,080	3,850	4,620	5,390	6,160	6,930
43.0	776	1,552	2,328	3,104	3,880	4,656	5,432	6,208	6,984
43.5	782	1,564	2,346	3,128	3,910	4,692	5,474	6,256	7,038
44.0	788	1,576	2,364	3,152	3,940	4,728	5,516	6,304	7,092
44.5	794	1,588	2,382	3,176	3,970	4,764	5,558	6,352	7,146
45.0	800	1,600	2,400	3,200	4,000	4,800	5,600	6,400	7,200
45.5	807	1,614	2,421	3,228	4,035	4,842	5,649	6,456	7,263
46.0	814	1,628	2,442	3,256	4,070	4,884	5,698	6,512	7,326
46.5	821	1,642	2,463	3,284	4,105	4,926	5,747	6,568	7,389
47.0	828	1,656	2,484	3,312	4,140	4,968	5,796	6,624	7,452
47.5	835	1,670	2,505	3,340	4,175	5,010	5,845	6,680	7,515
48.0	843	1,686	2,529	3,372	4,215	5,058	5,901	6,744	7,587
48.5	850	1,700	2,550	3,400	4,250	5,100	5,950	6,800	7,650
49.0	856	1,712	2,568	3,424	4,280	5,136	5,992	6,848	7,704
49.5	862	1,724	2,586	3,448	4,310	5,172	6,034	6,896	7,758
50.0	867	1,734	2,601	3,468	4,335	5,202	6,069	6,936	7,803
50.5	874	1,748	2,622	3,496	4,370	5,244	6,118	6,992	7,866
51.0	881	1,762	2,643	3,524	4,405	5,286	6,167	7,048	7,929
51.5	887	1,774	2,661	3,548	4,435	5,322	6,209	7,096	7,983
52.0	893	1,786	2,679	3,572	4,465	5,358	6,251	7,144	8,037
52.5	900	1,800	2,700	3,600	4,500	5,400	6,300	7,200	8,100
53.0	906	1,812	2,718	3,624	4,530	5,436	6,342	7,248	8,154
53.5	912	1,824	2,736	3,648	4,560	5,472	6,384	7,296	8,208
54.0	917	1,834	2,751	3,668	4,585	5,502	6,419	7,336	8,253
54.5	925	1,850	2,775	3,700	4,625	5,550	6,475	7,400	8,325
55.0	933	1,866	2,799	3,732	4,665	5,598	6,531	7,464	8,397
55.5	940	1,880	2,820	3,760	4,700	5,640	6,580	7,526	8,460
56.0	947	1,894	2,841	3,780	4,735	5,682	6,629	7,576	8,523
56.5	954	1,908	2,862	3,816	4,770	5,724	6,678	7,632	8,586
57.0	961	1,922	2,883	3,844	4,805	5,766	6,727	7,688	8,649
57.5	968	1,936	2,904	3,872	4,839	5,807	6,775	7,743	8,711
58.0	974	1,948	2,922	3,896	4,870	5,844	6,818	7,792	8,766
58.5	981	1,961	2,942	3,923	4,903	5,884	6,864	7,845	8,826
59.0	987	1,974	2,962	3,949	4,936	5,923	6,910	7,898	8,885
59.5	994	1,988	2,982	3,976	4,971	5,965	6,959	7,953	8,947
60.0	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000
60.5	1,006	2,013	3,019	4,026	5,032	6,039	7,045	8,052	9,059
61.0	1,013	2,026	3,039	4,052	5,065	6,078	7,091	8,104	9,117
61.5	1,020	2,040	3,060	4,080	5,100	6,120	7.140	8,160	9,180
62.0	1,027	2,054	3,081	4,108	5,135	6,162	7,189	8,216	9,243
62.5	1,033	2,067	3,100	4,134	5,167	6,201	7,234	8,268	9,302
63.0	1,040	2,080	3,120	4,160	5,200	6,240	7,280	8,320	9,360
63.5	1,047	2,094	3,141	4,188	5,235	6,282	7,329	8,376	9,423
64.0	1,054	2,108	3,162	4,216	5,270	6,324	7,378	8,432	9,486
64.5	1,060	2,121	3,181	4,242	5,302	6,363	7,423	8,484	6,545
65.0	1,067	2,134	3,201	4,268	5,335	6,402	7,469	8,536	9,603
65.5	1,074	2,148	3,222	4,296	5,370	6,444	7,518	8,592	9,666
66.0	1,081	2,162	3,243	4,324	5,405	6,486	7,567	8,648	9,729
66.5	1,088	2,176	3,264	4,352	5,440	6,528	7,616	8,704	9,792
67.0	1,095	2,190	3,285	4,380	5,475	6,570	7,665	8,760	9,855
67.5	1,102	2,205	3,307	4,410	5,512	6,615	7,717	8,820	9,922
68.0	1,110	2,220	3,330	4,440	5,550	6,660	7,770	8,880	9,990
68.5	1,117	2,235	3,352	4,470	5,587	6,705	7,823	8,940	10,058
69.0	1,125	2,250	3,375	4,500	5,625	6,750	7,875	9,000	10,125
69.5	1,133	2,265	3,398	4,530	5,663	6,795	7,928	9,060	10,193
70.0	1,140	2,280	3,420	4,560	5,700	6,840	7,980	9,120	10,260
70.5	1,147	2,295	3,442	4,590	5,737	6,885	8,032	9,180	10,327
71.0	1,155	2,310	3,465	4,620	5,775	6,930	8,085	9,240	10,395
71.5	1,162	2,325	3,487	4,650	5,812	6,975	8,137	9,300	10,462
72.0	1,170	2,340	3,510	4,680	5,850	7,028	8,190	9,360	10,530
72.5	1,177	2,355	3,532	4,710	5,887	7,065	8,242	9,420	10,597
73.0	1,185	2,370	3,555	4,740	5,925	7,110	8,295	9,480	10,665
73.5	1,193	2,386	3,579	4,772	5,965	7,158	8,351	9,544	10,737

Reduction of the electrical resistance of soils, etc.—Continued.

°F.	1000	2000	3000	4000	5000	6000	7000	8000	9000
74.0	1,201	2,402	3,603	4,804	6,005	7,206	8,407	9,608	10,809
74.5	1,208	2,416	3,624	4,832	6,040	7,248	8,456	9,664	10,872
75.0	1,215	2,430	3,645	4,860	6,075	7,290	8,505	9,720	10,935
75.5	1,222	2,445	3,667	4,890	6,112	7,335	8,557	9,780	11,002
76.0	1,230	2,460	3,690	4,920	6,158	7,380	8,610	9,840	11,070
76.5	1,237	2,475	3,712	4,950	6,187	7,425	8,662	9,900	11,137
77.0	1,245	2,490	3,735	4,980	6,225	7,470	8,715	9,960	11,205
77.5	1,253	2,506	3,759	5,012	6,265	7,518	8,771	10,024	11,277
78.0	1,261	2,522	3,783	5,044	6,305	7,566	8,827	10,088	11,349
78.5	1,269	2,538	3,807	5,076	6,345	7,614	8,883	10,152	11,421
79.0	1,277	2,554	3,831	5,108	6,385	7,662	8,939	10,216	11,493
79.5	1,285	2,576	3,856	5,142	6,427	7,713	8,998	10,284	11,569
80.0	1,294	2,598	3,882	5,176	6,470	7,754	9,058	10,352	11,646
80.5	1,302	2,609	3,906	5,208	6,510	7,812	9,114	10,416	11,718
81.0	1,310	2,620	3,930	5,240	6,550	7,860	9,170	10,480	11,790
81.5	1,318	2,637	3,955	5,274	6,592	7,911	9,229	10,546	11,866
82.0	1,327	2,654	3,981	5,308	6,635	7,962	9,289	10,616	11,943
82.5	1,335	2,670	4,005	5,340	6,675	8,010	9,345	10,680	12,015
83.0	1,343	2,686	4,029	5,372	6,715	8,058	9,401	10,744	12,087
83.5	1,351	2,702	4,053	5,404	6,755	8,106	9,457	10,808	12,159
84.0	1,359	2,718	4,077	5,436	6,795	8,154	9,513	10,872	12,231
84.5	1,367	2,735	4,102	5,470	6,837	8,205	9,572	10,940	12,307
85.0	1,376	2,752	4,128	5,504	6,880	8,256	9,632	11,008	12,384
85.5	1,385	2,769	4,153	5,538	6,922	8,307	9,691	11,076	12,460
86.0	1,393	2,786	4,179	5,572	6,965	8,358	9,751	11,144	12,537
86.5	1,401	2,802	4,203	5,604	7,005	8,406	9,807	11,208	12,609
87.0	1,409	2,818	4,227	5,636	7,045	8,454	9,863	11,272	12,681
87.5	1,418	2,836	4,254	5,672	7,090	8,508	9,931	11,344	12,762
88.0	1,427	2,854	4,281	5,708	7,135	8,562	9,989	11,416	12,843
88.5	1,435	2,870	4,305	5,740	7,175	8,610	10,040	11,480	12,915
89.0	1,443	2,886	4,329	5,772	7,215	8,658	10,091	11,544	12,987
89.5	1,451	2,903	4,354	5,806	7,257	8,709	10,155	11,612	13,063
90.0	1,460	2,920	4,380	5,840	7,300	8,760	10,220	11,680	13,140
90.5	1,468	2,937	4,405	5,874	7,342	8,811	10,279	11,748	13,216
91.0	1,477	2,954	4,431	5,908	7,385	8,462	10,339	11,816	13,293
91.5	1,486	2,972	4,458	5,944	7,430	8,916	10,402	11,888	13,374
92.0	1,495	2,990	4,485	5,980	7,475	8,970	10,465	11,960	13,455
92.5	1,504	3,008	4,512	6,016	7,520	9,024	10,528	12,032	13,536
93.0	1,513	3,026	4,539	6,052	7,565	9,078	10,591	12,104	13,617
93.5	1,522	3,035	4,567	6,090	7,612	9,135	10,657	12,180	13,702
94.0	1,532	3,064	4,596	6,128	7,660	9,192	10,724	12,256	13,788
94.5	1,541	3,083	4,624	6,166	7,707	9,249	10,790	12,332	13,873
95.0	1,551	3,102	4,653	6,204	7,755	9,306	10,857	12,408	13,959
95.5	1,560	3,121	4,681	6,242	7,802	9,363	10,923	12,484	14,040
96.0	1,570	3,140	4,710	6,280	7,850	9,420	10,990	12,560	14,130
96.5	1,580	3,160	4,740	6,320	7,900	9,480	11,060	12,640	14,220
97.0	1,590	3,180	4,770	6,360	7,950	9,540	11,130	12,720	14,310
97.5	1,600	3,201	4,801	6,402	8,002	9,603	11,203	12,804	14,404
98.0	1,611	3,222	4,833	6,444	8,055	9,666	11,277	12,888	14,499
98.5	1,620	3,240	4,860	6,480	8,100	9,720	11,340	12,960	14,580
99.0	1,629	3,258	4,887	6,516	8,145	9,774	11,403	13,032	14,661

Directions for estimating soluble salts in soils.—Take a known volume (or weight) of saturated soil, wash into a 250 c. c. flask and fill to the mark with distilled water, and filter if necessary. Take 50 c. c. of the solution and titrate with N/20 acid potassium sulphate, containing 6.758 grams per liter, using phenolpthalein as an indicator. This will represent the carbonates. Then add a drop or so of methyl orange or congo red and again titrate with N/20 acid potassium sulphate. Sub-

tract an amount equal to the first titration from the second and the difference represents the bicarbonates. Add a few drops of potassium chromate as an indicator to the same solution and titrate with N/10 silver nitrate. This will represent the chlorides. The salts are all to be estimated as sodium salts as follows:

1 c. c. N/20 $HKSO_4$ is equivalent to 0.005266 gram Na_2CO_3.
1 c. c. N/20 $HKSO_4$ is equivalent to 0.004172 gram $NaHCO_3$.
1 c. c. N/10 $AgNO_3$ is equivalent to 0.005806 gram NaCl.

In areas where the amount and distribution of sodium carbonate warrant it, construct the sodium carbonate map in the field from the volume of solution used. Limiting values will be 0.3, 0.2, 0.1, and 0.05 per cent of dry soil. The limiting values for each vessel are found in the following way: Multiply the volume of saturated soil, represented by the solution taken for titration, by the numbers in the following table:

Na_2CO_3 in soil.	s. and ssc.	sc.	scc.	c. and hc.
Per cent.				
0.30	0.832	0.752	0.720	0.689
.20	.554	.502	.480	.459
.10	.277	.251	.240	.230
.05	.138	.125	.120	.115

These results so obtained are the cubic centimeters of N/10 solution of sodium carbonate corresponding to the limiting values, to be inserted in the following table:

Na_2CO_3 in soil.	s. and ssc.	sc.	scc.	c. and hc.
Per cent	*cc.*	*cc.*	*cc.*	*cc.*
0.30	.....	.....	.....	.....
.20	.....	.....	.....	.....
.10	.....	.....	.....	.....
.05	.....	.....	.....	.....

If it is desired to reduce the volume of N/10 $AgNO_3$ to per cent of NaCl in dry soil the following formula may be used:

$$\frac{V\ 0.005806}{V'\ K}$$

Substituting 0.004172 for 0.005806, the same formula may be used to reduce the volume of N/20 $HKSO_4$ to per cent of $NaHCO_3$. V = cubic centimeters N/10 $AgNO_3$ or N/20 $HKSO_4$ solution used; V′ = volume saturated soil represented in amount of solution titrated; K = constant for type of soil as follows:

s. and ssc. = 1.46; sc. = 1.32; scc. = 1.26; c. and hc. = 1.21.

Construction of alkali maps.—The directions for mapping alkali soils in the field, just given, which are also to be found in the front of the Alkali Field Book, will enable you to determine the percentage of alkali in any sample of soil. It has been the practice of this Bureau to prepare maps showing the percentage of alkali in the surface 6 feet of soil. This has generally been considered to be a mathematical average of the salt content of the 6 feet; but in nearly all cases the judgment of the person in charge of the work as to the actual crop value of the soil on the basis of alfalfa has entered into the construction of the maps.

To do away as much as possible with this element of judgment and to place the construction of the maps entirely upon a percentage basis—that they may be of equal value when any crop is considered—and to permit the strict comparison of the work done by different men, the following plan is to be adopted:

The percentage of alkali salts in each foot of land to a depth of 6 feet will be determined according to the directions in the front of the Alkali Field Book. In many cases after the observer becomes familiar with the soils of a locality the field work may be very much shortened by making the alkali determinations in alternate foot sections or by mixing 2 or more feet for one salt determination.

The percentage of alkali, as indicated by the various colors upon the alkali map, is to be a mathematical average of the alkali in the foot sections. In case there should be a marked accumulation of the alkali at any one part of the vertical section, such as the surface of the ground or in an alkali hardpan, the judgment of the observer is to decide whether the strict mathematical average should be followed or whether the soil is to be mapped as of the next higher grade of alkali content. If these areas, where there is a zone of accumulation of the alkali such as an accumulation at the surface, are of considerable extent, they are to be indicated upon the field map by special rulings in lead pencil, and when the field maps are published the rulings will be described in the legend of the map. Thus, if a soil contain on an average 0.2 per cent of alkali, but has an accumulation of 0.5 per cent of alkali on the surface, this soil should be colored to show 0.2 per cent alkali, and the fact that there is a surface accumulation should be indicated by black rulings across the area affected. If the accumulation is below the surface foot another kind of ruling can be used to indicate that fact. Appropriate lettering upon the maps will render these rulings intelligible.

Salt in irrigation and seepage waters.—The following table, giving the relation between the electrical resistance and the salt content of irrigation and seepage waters, is based upon the composition of the alkali of Salt Lake Valley, Utah.

Fill the electrolytic cell with water and take the resistance. Take the temperature with an ordinary thermometer and reduce to 60° F.

by use of the table on pages 19 to 21. The salt content corresponding to this resistance may be found from the following table:

Resistance and concentration of salt solution in cell No. 1.

[Capacity 48 c. c., cell factor 3.53, based on composition of Utah alkali.]

Resistance at 60° F.	Parts per 100,000.	Resistance at 60° F.	Parts per 100,000.
Ohms.		*Ohms.*	
20	1,165	130	158
21	1,105	140	146
22	1,050	150	136
23	1,000	160	127
24	955	170	119
25	915	180	111
26	879	190	104
27	846	200	98
28	815	220	89
29	785	240	81
30	756	260	73
35	633	280	67
40	546	300	62
45	482	350	52
50	431	400	44
55	388	450	39
60	353	500	35
65	323	600	28
70	298	700	23
75	276	800	19
80	258	900	16
85	242	1,000	14
90	228	1,200	12
95	216	1,400	11
100	206	1,600	10
110	188	1,800	9
120	172	2,000	8

If there is any great difference between the composition of the salts to be examined and that of those occurring in Utah (from which the above table was made), there may be an error in the solutions having a concentration of 1 per cent, amounting to as much as 20 per cent of the salts present. In extremely dilute solutions there will be no error.

The electrolytic cells are made of as nearly the same dimensions as possible, but if there is much variation in either volume or shape this table could not be used without a correction for the cell.

If greater accuracy is desired than can be expected by the use of the above table, proceed in the following way:

Collect 6 or 8 samples of water from different parts of the area; determine the electrical resistance of each, and take an amount of each proportional to the resistance, mixing them in a clean vessel. There should be at least 2 quarts, and preferably 1 gallon, of this mixture. Evaporate slowly on a stove until the mixture is about as strong as the strongest water likely to be encountered. If there is any possibility of encountering water as strong as a 1 per cent solution,

that is, 1,000 parts of salts in 100,000 parts of water, the mixture should be evaporated until it gives a resistence in the cell of about 23 ohms. The amount of this evaporation can be determined by the original resistance of the mixture. If the resistance of the mixture is 100 ohms, it should be evaporated to one-fourth its volume to make approximately a 1 per cent solution. If the resistance is 400 ohms, the solution should be evaporated to one twenty-third of its original volume. Water having a resistance of 400 ohms would have a salt content according to the above table of about 44 in 100,000, and would be considered an excellent water for irrigation purposes. It would require 3 gallons of such water, evaporated to 1 pint, to make a 1 per cent solution.

To determine the actual per cent of salt in this solution, after finding the resistance in a cell, evaporate in a weighed vessel—such as a tin cup or a tin can—a separate, weighed amount of the water. Weigh the vessel again after the evaporation, and this will give the amount of residue in a known weight of water. The weighing should be carefully done on reliable druggists' scales,

Take the concentrated solution and dilute with successive quantities of distilled water, so as to change the concentration of the solution and get the corresponding resistances in the cell. Use, for example, 9 parts of the solution and 1 part distilled water, then 8 parts of the solution and 2 parts of distilled water, and so on down to any dilution likely to be encountered. This will give the resistance corresponding very exactly with known amounts of salt, and will furnish a table for the estimation of the salt content from the resistance of any water in the area.

The table constructed from this data can be used directly by interpolation, or preferably a curve should be constructed and any intermediate points picked out from this.

Form of a soil-survey report.—Owing to the large amount of data being collected by the soil-survey parties, it will be necessary to confine the reports from each party to about 50 typewritten pages of 250 words each or 25 printed pages of 500 words each for the Western Division and to about 15 or 20 printed pages for the Eastern Division. The material for the report should be collected and written up, so far as possible, before the party leaves the field.

An outline of the chapters is given as a guide in the arrangement of the report, and should be followed as closely as circumstances will permit. The number of words to be given in each chapter will be a guide in the preparation of the material and is given as the result of experience in former reports. It is understood, of course, that the headings will necessarily have to be changed somewhat in different districts and the relative importance of the different chapters will vary with the locality. This is intended, therefore, simply as a guide in the preparation of the reports, and the number of words should be

taken as the maximum to be used except in the case of matters of special importance, which may need fuller treatment.

The matter should be presented in a terse style, and no more words used than are absolutely necessary to convey the meaning, being careful, however, to treat each subject so that all important phases may be brought out and clearly stated. In order to attain this, the different chapters should be revised several times if necessary, so that all important matters may be considered and all unnecessary words eliminated. A careful consideration of this matter of style in writing is enjoined upon all members of the division charged with the preparation of reports.

The subtopics under No. V—Soils, No. IX—Alkali in soils, and No. XII—Agricultural conditions, are not to be specifically mentioned in the report, but are given merely to show the order in which the soils should be described and the principal subjects that should be considered in the study of each type.

The outline of chapters referred to is as follows:

Outline of soil survey report—

I. Location and Boundaries of the Area (250 words).
II. History of Settlement and Agricultural Development (750 words).
III. Climate.
IV. Physiography and Geology (1,000 words).
V. Soils (500 words to each type).
    Name, description, and depth of soil and subsoil.
    Location of soil in area.
    Physiography.
    Drainage features.
    Origin of soil and processes of formation.
    Important mineral or chemical features. Alkali salts.
    Crops grown and average yields.
    Crops to which adapted.
VI. Special Soil Problems, such as Hardpan, Acid Soils (1,000 words).
VII. Water Supply for Irrigation, Amount and Character (1,000 words).
VIII. Underground and Seepage Waters, Drainage of Soils (1,000 words).
IX. Alkali in Soils (2,000 words).
    Location of alkali areas.
    Origin of alkali.
    Chemical composition of alkali.
    Distribution in soil.
X. Reclamation of Swamp, Worn-out Lands, or Alkali Lands (1,000 words).
XI. Agricultural Methods in Use, Cultivation, Cropping, Rotation, Irrigation, etc.
XII. Agricultural Conditions in the Area (2,000 words).
    General prosperity of farming class.
    Tenure of farms.
    General size of farms.
    Character and efficiency of labor.
    Character of principal products.
    Recognition of adaptation of soils to crops.
    Transportation facilities.
    Markets.
XIII. Acknowledgment of Material for Report, Maps, Photographs, etc.

SOIL TYPES RECOGNIZED BY THE BUREAU OF SOILS.

STONY LOAM.

Allegan Stony Loam.—Ten inches of silty loam, underlaid by heavy red clay slightly silty to a depth of 30 inches, in turn underlaid by beds of consolidated gravel. From 20 to 60 per cent of rounded and angular stones on the surface and mixed with both soil and subsoil. Stones vary from 1 to 8 inches in diameter. Surface generally consists of large rounded hills and tablelands and of gently rolling lands at lower levels. Chiefly derived from morainic material. In the level areas soil is very productive. Good crops of corn, wheat, grass, oats, and pasture are grown, especially in the eastern part of the county. In the western part of the county peaches, apples, pears, and plums are grown, besides general farm crops. Very fertile.

	Acres.
Allegan County sheet, Michigan	76,790

Bingham Stony Loam.—Sandy loam, 4 to 6 feet deep, containing stones and bowlders, underlaid by bed rock and masses of bowlders. These often project above the surface. Lower slopes of the mountains, Salt Lake and Weber counties, Utah. Has no agricultural value at present, being too stony, and besides usually lying too high for irrigation. But for this disadvantage of position in most areas, and the scarcity of water in others, some part of this soil might be used in fruit growing.

	Acres.
Salt Lake sheet, Utah	16,600
Sevier Valley sheet, Utah	4,210
Weber County sheet, Utah	5,700

Clarksville Stony Loam.—Whitish silty loam 6 inches in depth, overlying heavy yellowish red clay 3 feet or more in depth. Both soil and subsoil contain 20 to 50 per cent of angular fragments of chert, locally known as gravel. Rough, broken country with deep-cut, narrow valleys. Residual soil derived from marine crinoidal limestone of St. Louis group. High, well-drained country, originally heavily forested with oak and chestnut. Soils are thin and stony and of little agricultural value, and at present largely covered with thick second growth of oak timber.

	Acres.
Clarksville sheet, Tennessee	66,450

Edgemont Stony Loam.—This soil is derived from the weathering of fine-grained siliceous sandstones or quartzites, typically found along the eastern slopes of the Appalachian Mountains. The soil consists of a thin layer of sandy loam, more or less stony, which grades into a loose mass of sandstones and slates. The surface is strewn with 30 to 60 per cent of angular pieces of flat, flaggy sandstone. The soil is not strong or productive, but fruit grown upon it is of superior beauty and flavor. The mountain peach industry of Maryland has been developed on this type.

The greater part of the ridges is covered with chestnut, locust, and oak timber; besides, fruits, corn, oats, rye, and potatoes are grown to a limited extent. Wheat produces a small crop of bright, heavy grain.

	Acres.
Lancaster County sheet, Pennsylvania	13,000
Lebanon sheet, Pennsylvania	20,300

Garner Stony Loam.—A sandy loam containing 40 to 60 per cent of rock fragments and gravel. At a depth of 6 to 15 inches it overlies a red, tenacious, brick-clay subsoil, which also contains sand, gravel, and stones. It is found along stream courses and probably owes its origin to stream action at times of overflow. Tillage is difficult, but fair crops of cotton can be raised. It is devoted to the growth of commercial pine timber and used for hog and cattle pastures.

	Acres.
Clayton sheet, North Carolina	13,350
Princeton sheet, North Carolina	980

Hempfield Stony Loam.—Soil is derived from the weathering of intrusive dikes of fine-grained trap (diabase) rock. It occupies small, isolated patches and strips near the eastern foot of the Appalachian Mountains. The soil consists of 12 inches of red loam mixed with 30 to 60 per cent of rounded "iron-stone" bowlders. The subsoil is a heavy clay loam also containing bowlders. This soil produces good crops when cleared of stone, but does not occupy large or important areas. It could probably be correlated with the stony phase of the Cecil clay.

	Acres.
Lancaster County sheet, Pennsylvania	1,400

Herndon Stony Loam.—Grayish yellow or brown sandy loam or loam, 12 inches deep, overlying yellowish or red clay mixed with loose masses of broken rock. On the surface from 40 to 85 per cent of stones and bowlders are scattered about. Steep slopes or crests of mountains. Derived from the weathering of coarse-grained gneisses and similar rocks. On account of steep slopes, abundance of bowlders, and tendency to wash, of little value for agriculture. Some fair.

bright tobacco, corn, and wheat grown. Fruit is grown also to a limited extent, and soil best adapted to this product.

	Acres.
Alamance County sheet, North Carolina	4,960
Cobb County sheet, Georgia	2,020
Statesville sheet, North Carolina	8,130

Holyoke Stony Loam.—This soil is of glacial origin, and consists of about 3 feet of loam, containing 10 to 50 per cent of diabase and other bowlders. The areas occupied are rough and mountainous, occurring along the base of diabase ranges. The soil is chiefly devoted to pasture, though it is used also to some extent for fruit.

	Acres.
Hartford sheet, Connecticut and Massachusetts	19,730

Manor Stony Loam.—Reddish-yellow loam, 12 inches deep, with 20 to 60 per cent of broken fragments of schist; subsoil to depth of 3 feet is slightly heavier than the soil and deeper red in color, underlaid by a mass of broken fragments of schist. Rolling upland of the Piedmont Plateau. Derived from decomposition of chlorite schists and similar rocks. Recognized as fairly productive soil for general agricultural purposes.

	Acres.
Lancaster County sheet, Pennsylvania	3,500

Murrill Stony Loam.—Grayish-yellow sandy loam, 10 inches deep, mixed with fragments of sandstone and other rocks. Subsoil grades from reddish-brown clay loam to a stiff red clay in lower depths, and contains some coarse sand and a large percentage of sandstone fragments. Rolling valley lands and gentle slopes of mountains. Soil is colluvial, derived from wash from mountains, but subsoil is derived from decomposition of underlying rocks. Produces good crops—wheat, corn, grass, tobacco, and rye.

	Acres.
Bedford County sheet, Virginia	11,950

Penn Stony Loam.—Very stony land, mountainous in character, and generally covered with a natural forest of chestnut and oak. It consists of a rather heavy loam, 8 to 10 inches deep, containing from 30 to 90 per cent of sandstone fragments. The subsoil is of much the same character to a great depth. This type is derived from the more siliceous or hardened phase of the Triassic brown sandstone. It is not suited to tillage, but it is well adapted to forestry and orcharding. The chestnut and peach industries seem to have great promise here.

	Acres.
Lebanon sheet, Pennsylvania	49,160

Plainwell Stony Loam.—Loose yellow sandy loam, 8 inches deep, underlaid by loose yellow medium and fine sand to a depth of 3 feet

or more. From 20 to 70 per cent of stones and large bowlders scattered on the surface and mixed with the soil and subsoil. Large rounded hills and ridges. Derived from morainic material. Corn, rye, and buckwheat are grown to some extent, but the yields of these crops are low.

	Acres.
Allegan County sheet, Michigan	4,150

Triassic Stony Loam.—A red sandy loam containing 10 to 40 per cent of gravel and bowlders of all sizes and shapes. This soil occurs on hills of glacial material scattered through the late sedimentary deposits of the Connecticut Valley and forming the lower slopes of the valley walls. Habana seed tobacco is raised on this soil, and it also produces good general farm crops.

	Acres.
Hartford sheet, Connecticut and Massachusetts	37,180

Yakima Stony Loam.—Basaltic bowlders and outcroppings in too great quantity to permit of cultivation. Spaces between bowlders occupied by small patches of Yakima sandy loam. Occurs on hillsides and plateaus in valleys. Well drained and free from alkali.

	Acres.
Yakima sheet, Washington	6,590
Sunnyside sheet, Washington	2,370

GRAVEL.

Arroyo Seco Sandy Loam.—Dark-brown or yellowish coarse sandy loam containing a large percentage of coarse, well-rounded gravel and small bowlders of granitic origin. Sometimes becoming compact and very hard at surface. Found upon gently sloping fans. Derived from stream wash from mountains. Somewhat deficient in organic matter. Adapted to grains if well irrigated, but irrigation is very difficult on account of loss by seepage through coarse subsoil. Yield fair in favorable seasons. Free from alkali.

	Acres.
Soledad sheet, California	9,570

Dunkirk Gravel.—Very gravelly soil of old lake beaches, occurring in narrow bands between the lake and uplands. Waterworn fragments of shale, 6 feet or more deep. At present used extensively for grape culture, but grapes do not keep so well or bear shipment so well as those grown on Dunkirk clay. Soil is quite droughty and not well suited to other crops.

	Acres.
Westfield sheet, New York	4,840

Pecos Conglomerate.—Sandy loam to a depth of 2 feet, containing a high percentage of rounded gravel, resting upon conglomerate or gravel beds. Bench land and bluffs. Soil derived from disintegration of conglomerate beds; well drained and free from alkali salts; readily

transmits seepage waters. Not adapted to any agricultural purpose at present.

	Acres.
Carlsbad sheet, New Mexico	11,680

River Wash.—Coarse sand and bowlders, generally in long, narrow areas; subject to overflow in times of flood; occupying bottoms of river channels through arid West. No agricultural value.

	Acres.
Fresno sheet, California	480
Salinas sheet, California	3,170
San Gabriel sheet, California	16,230
Sevier Valley sheet, Utah	1,300
Soledad sheet, California	7,590
Ventura sheet, California	13,610
Yakima sheet, Washington	3,580

Salt River Gravel.—Coarse gravel of undetermined depth. Bluff along Salt River, Arizona. Of no present agricultural value.

	Acres.
Salt River Valley sheet, Arizona	1,804

Susquehanna Gravel.—Hills and narrow bands of gravel along Atlantic seaboard. The soil is a gray loam about 12 inches deep, containing 30 to 60 per cent of rounded white quartz gravel. The subsoil varies, but is usually clay or gravel beds. Formed from denudation of gravel layers deposited as shallow water sediment or as river wash or delta. Is a poor, unproductive soil, lying on slopes, and should be reforested.

	Acres.
Calvert County sheet, Maryland	3,900
Cecil County sheet, Maryland	45,600
Clayton sheet, North Carolina	8,030
Harford County sheet, Maryland	12,930
Kent County sheet, Maryland	12,490
Prince George County sheet, Maryland	41,470
Princeton sheet, North Carolina	3,380
St. Mary County sheet, Maryland	7,350

GRAVELLY LOAM.

Allegan Gravelly Loam.—Soil to depth of 9 inches consists of sandy, gravelly loam, usually underlaid to a depth of several feet by a ferruginous gravel hardpan. Gravel content varies from 25 to 60 per cent. Gravel ranges in diameter from one-half inch to 6 inches. Derived from glacial material, and usually occurring as ridges or knolls. Peaches, pears, cherries, plums, apples, and small fruits are grown to a considerable extent. Also used for general farming, and good crops of corn, wheat, and grass are produced.

	Acres.
Allegan County sheet, Michigan	4,810

Bingham Gravelly Loam.—Sandy loam, 6 feet or more in depth, containing gravel within 3 feet or less of the surface; always well drained.

Gravel usually from one-half inch to 1½ inches in diameter, generally increasing in amount in lower depths. High bench lands and sloping valley floors in narrow valleys. When too high for irrigation this soil is used to some extent for dry farming to wheat; when irrigated it forms desirable land for alfalfa, grain, and fruit. Considerable seepage from canals.

	Acres.
Sevier Valley sheet, Utah	38,400
Salt Lake sheet, Utah	35,280

Chicopee Gravel Loam.—A coarse sandy loam, containing 20 to 40 per cent of rounded white quartz gravel from one-half inch to 2 inches in diameter. Occupies level plains in recent sedimentary deposits. It represents the shallow-water contributions of swiftly flowing lateral streams of large size. Has no present agricultural value.

	Acres.
Hartford sheet, Connecticut and Massachusetts	10,900

Donegal Gravelly Loam.—Occurs as poorly marked river terraces along the lower course of the Susquehanna River. Sandy loam 12 inches deep with rounded river gravel seldom exceeding 30 per cent, underlaid by same material slightly more gravelly. Deposited by the river when swelled by large volume of water from melting glacial ice to the north, which carried with it sands and gravels of glacially derived materials. Adapted to market gardening and wrapper tobacco. Too light for general agriculture.

	Acres.
Lancaster County sheet, Pennsylvania	4,000
Lebanon sheet, Pennsylvania	13,350

Dunkirk Gravelly Loam.—A sandy loam containing from 40 to 60 per cent of very fine gravel, which consists of waterworn fragments of shale. The soil is underlaid at about 3 feet by shale fragments or sand. Occurs in bands along foot of low ridges on lake forelands and also upon uplands. Has the characteristics of an ancient beach or bar and was probably derived from deposition by water. Sometimes has larger gravel scattered over the surface. It is a well-drained early soil, adapted to market-garden and truck crops. It is not well suited for most general farming crops, but is a typical corn soil. Grapes are sucessfully grown.

	Acres.
Westfield sheet, New York	7,260

Kalamazoo Gravelly Loam.—Eight inches of coarse sand mixed with fine waterworn gravel, underlaid by coarse sand containing slightly increased amount of fine gravel to a depth of 3 feet or more. Gravel content varies from 5 to 20 per cent in soil and from 10 to 25 per cent in subsoil. Gravel rarely exceeds 1 inch in diameter. Gently rolling uplands and well-defined river terraces. Derived from glacial material considerably modified by water action. Porous soil, well drained; gen-

erally considered too light for best results for general farm crops, such as corn, wheat, and grass, but used to slight extent for truck, peaches, and cherries.

	Acres.
Allegan County sheet, Michigan	14,160

Leonardtown Gravelly Loam.—Gravelly loam containing from 15 to 30 per cent of fine and medium gravel with some sand. Average depth, 9 inches, underlaid by compact yellow loam mingled with sand and gravel, in turn underlaid at a depth of 30 inches by gravel and sand. Distinguished from Susquehanna gravel by larger proportion of fine earth, and from Sassafras gravelly loam by heavier and deeper subsoil. Surface rolling. Best adapted to corn, but good for wheat, grass, and truck.

	Acres.
Prince George County sheet, Maryland	3,710

Maricopa Gravelly Loam.—Light, sandy loam, with 10 to 40 per cent of rounded gravel and stones to a depth of 6 feet or more. Lower mountain slopes and margins of valley lands. Colluvial soil, first product of the waste from the mountain slopes. Excellent fruit soil when favorably situated for irrigation.

	Acres.
Salt River Valley—Tempe and Phœnix sheets, Arizona	51,066

Miami Gravelly Loam.—Brown or reddish loam, 12 inches deep, with 15 to 30 per cent of rounded gravel, underlaid to a depth of 24 inches by a stiff, tenacious clay loam, which is in turn underlaid by a layer of gravel. Level or gently rolling river terraces. Originally glacial material, worked over by the river and streams. Recognized as fine land for general farm purposes.

	Acres.
Montgomery County sheet, Ohio	24,000

San Gabriel Gravelly Loam.—Dark brown loam, 6 feet or more in depth, containing 20 to 30 per cent of granitic gravel, from size of pea to 1½ inches in diameter. Occupies abrupt slopes at the foot of mountains. Larger areas are comparatively level. Once extensively planted to vines, but now largely planted to citrus fruits. Vines and deciduous trees do not need irrigation, because proximity to mountains results in greater rainfall. Always well drained and free from alkali.

	Acres.
Ventura sheet, California	4,307
San Gabriel sheet, California	15,360

Sassafras Gravelly Loam.—Occupies sloping upland areas along northern Atlantic coast. The soil is a brown gravelly loam containing 15 to 35 per cent of round quartz gravel from one-half inch to 2 inches in diameter. The subsoil consists of a red gravelly loam resting on a sandy and gravelly base. The gravel is all of small size, considerably iron stained, and usually well compacted by interstitial sand and loam.

This soil is well drained and easily tilled. It is a fair corn soil and excellent for orchard fruits like peaches, plums, and pears

	Acres.
Salem sheet, New Jersey	43,210
Kent County sheet, Maryland	8,060

Soledad Gravelly Sand.—Very coarse brown sand and fine gravel, composed of sharp fragments of granitic rocks and 6 feet or more in depth. Occurs upon large fans of from 3° to 5° slope extending from granitic foothill formation. Surface sometimes becomes compact and very hard, especially when packed in roads. Rather deficient in plant food and not retentive of moisture. Adapted to grain, with fair yield in favorable seasons Free from alkali.

	Acres.
Salinas sheet, California	230
Soledad sheet, California	7,370

DUNESAND.

Dunesand.—Soil consists of incoherent sand to a depth of 3 feet or more, often exceeding 100 feet. Occupies hillocks, rounded hills, or ridges from 2 to 175 feet in height. Found along shores of lakes or ocean and in deserts. At present generally of no agricultural value on account of the irregular surface and the unstable and drifting nature of the sand, but in arid regions often very productive when leveled and under irrigation.

	Acres.
Allegan County sheet, Michigan	3,130
Imperial sheet, California	29,840
Ventura sheet, California	2,020

SANDHILL.

Sandhill.—Coarse, loose, incoherent sand, 10 feet or more in depth. Hills from 20 to 200 feet or more in height, representing old shore lines of the ocean or formed by river action and wind, occurring as long, narrow ranges and frequently as isolated hills. Material is generally so loose and incoherent and so thoroughly drained that it seldom has any agricultural value.

	Acres.
Craven sheet, North Carolina	140
Kinston sheet, North Carolina	2,200
Newbern sheet, North Carolina	960
Princeton sheet, North Carolina	2,160

SAND.

Allegan Sand.—Soil to depth of 12 inches consists of reddish-brown, light, sandy loam, underlaid by loose medium to fine sand to a depth of 3 feet or more. In certain localities the depth of sand exceeds 30 feet. Rolling lands composed of low, rounded ridges and knolls, with occasional broad level areas. Derived from shallow lake sediments

and glacial sand plains. In Allegan County, Mich., where soil was first observed, agricultural value varies. South of Kalamazoo River, near the lake, peaches, cherries, plums, and small fruits are successfully grown. It is one of the best peach soils in the county. Considerable corn and rye are also grown. Original timber growth consisted of hard wood exclusively. North of Kalamazoo River, near Lake Michigan, the timber growth consisted of hard wood, with some pine. Peaches, cherries, plums, and small fruits, and corn and rye are grown with moderate success. In the northern and southern extremities of large inland area original timber growth consisted of heavy pine. Has not as yet been developed. In some few instances corn, rye, buckwheat, and peaches are grown. On the pine plains proper the original timber growth consisted of a sparse, light growth of pine. Here soil is almost entirely undeveloped at the present time. Small crops of corn and rye are produced, but no peaches.

	Acres.
Allegan County sheet, Michigan	117,480

Beaufort Sand.—Black, sandy soil, from 3 to 12 inches deep, mixed with a large amount of organic matter and underlaid by yellow sand of a sticky nature, which is in turn underlaid at a depth of from 2 to 3 feet by a yellow sand resembling quicksand. Found on low divides in Atlantic Coastal Plain. Almost entirely uncultivated and covered by a sparse growth of pines, wire grass, and scattering shrubs. Will produce good quality of bright tobacco.

	Acres.
Craven sheet, North Carolina	10,600

Cassadaga Sand.—Coarse orange or gray sand 1 to 3 feet or more deep. Occurs usually in upland valleys. Inclined to be wet or marshy, and needs drainage because of a hardpan subsoil. Very little under cultivation, is usually wooded, and generally has a thick growth of underbrush. Has at present little agricultural value. If it were cleared and drained it would probably be suited to grass.

	Acres.
Westfield sheet, New York	1,660

Clyde Sand.—The soil consists of 12 inches of black medium and fine sandy loam, underlaid by sand to a depth of 30 inches, in turn generally underlaid by clay. Occupies low, flat lands, generally swampy, and borders stream courses. When well drained produces good crops of corn, wheat, grass, oats, rye, and all kinds of truck crops. Excellent soil for sugar beets.

	Acres.
Allegan County sheet, Michigan	38,600

Elsinore Sand.—Coarse river sand, sometimes containing river-washed gravel, always underlaid by gravel. An unimportant type occurring along streams.

	Acres.
Sevier Valley sheet, Utah	1,900

Fresno Red Sand.—This soil consists of compact red sand of medium texture to a depth of 6 feet or more. It is derived from disintegration of crystalline rocks. This material has been carried down from the mountains and distributed usually in gentle slopes by foothill streams. The surface is also somewhat modified by wind action. It is well drained, free from alkali, and adapted to vines, stone fruits, and truck crops.

	Acres.
Fresno sheet, California	43,776

Fresno Sand.—Coarse, loose, incoherent sand, 6 feet or more in depth, naturally free from alkali. Level plains, deltas; origin, river wash. Adapted to stone fruits and truck when irrigated; occasionally dry-farmed to wheat. Is used for English walnuts. Similar to Norfolk sand truck soils of the Eastern States.

	Acres.
Fresno sheet, California	163,200
Hanford sheet, California	20,790
Salinas sheet, California	11,560
San Gabriel sheet, California	15,190
Santa Ana sheet, California	66,380
Soledad sheet, California	13,470
Ventura sheet, California	6,430
Weber County sheet, Utah	21,800

Imperial Sand.—Sand 5 feet deep, underlaid by loam or clay. The sand is generally well drained and free from harmful quantities of alkali, but the loam or clay subsoil contain alkali in excess, which will rise to the surface, to the detriment of the land, should excessive irrigation be practiced. This soil is adapted to any of the crops suitable to the climate.

	Acres.
Imperial sheet, California	1,020

Jordan Sand.—Medium to fine sand, 6 feet or more in depth. High bluffs; in places occurs as dunes; well drained and free from alkali. River deposit, generally lying too high for irrigation. This soil is not well adapted to general crops on account of its position, open texture, and dry nature.

	Acres.
Salt Lake sheet, Utah	3,020
Weber County sheet, Utah	1,900

Norfolk Sand.—Coarse to medium sand, friable and not cohering. Possesses small percentage of silt and clay. Is a common type along the low, flat river necks and forelands of the Atlantic Coastal Plain. It is also found along the steep valley slopes of the streams of the region. It is a typical truck soil. Sweet potatoes, watermelons, cantaloupes, and early tomatoes are raised with profit. The Maryland type of export tabacco is partly produced on this soil. The surface soil usually contains more organic matter than the subsoil and is

therefore slightly more loamy. This type resembles Hartford sandy loam and Fresno sand.

	Acres.
Calvert County sheet, Maryland	58,000
Cecil County sheet, Maryland	46,600
Craven sheet, North Carolina	87,930
Harford County sheet, Maryland	2,470
Kent County sheet, Maryland	30,760
Kinston sheet, North Carolina	45,030
Newbern sheet, North Carolina	18,870
Prince George County sheet, Maryland	23,630
Princeton sheet, North Carolina	8,280
St. Mary County sheet, Maryland	27,500
Salem sheet, New Jersey	78,410
Willis sheet, Texas	8,560

Norfolk Sandy Soil.—Coarse, yellow sandy soil, 6 to 12 inches deep; coarse, yellow sandy subsoil, resting on red or yellow clay, 18 to 30 inches deep. Level or gently rolling land of the Coastal Plain region, Atlantic Coast States. Adapted to early truck, bright tobacco, and cotton, according to situation as regards ocean and climatic conditions.

	Acres.
Clayton sheet, North Carolina	57,810
Kinston sheet, North Carolina	8,640
Princeton sheet, North Carolina	37,460

Oxnard Sand.—Brownish sand, consisting chiefly of quartz particles, medium to fine in texture, 6 feet or more in depth. Occurs on river deltas. When first cultivated is shifted by the winds, and in Ventura County, Cal., protection by wind-breaks of trees is necessary. The grains of sand have been somewhat rounded by wind action. This soil is best adapted to lima beans and English walnuts, which are grown both with and without irrigation. On alkaline areas sugar beets are successfully grown. Barley and corn are also grown.

	Acres.
Ventura sheet, California	16,198

Pecos Sand.—Fine sand, 6 feet or more in depth, except where drifted over other formations. Lies along rivers by which it has been transported from the mountains. The action of the wind has extended the areas, and the surface is usually covered with dunes. The soil is calcareous and contains small amounts of alkali, though not enough to injure plants. Characteristic vegetation, mesquite, willow, canaigre, yucca, and cottonwood. Generally well drained. Adapted to truck, fruit, melons, potatoes, and root crops.

	Acres.
Carlsbad sheet, New Mexico	2,809
Salt River Valley sheet, Arizona	13,960

Salt Lake Sand.—Sand consisting of about 80 per cent medium-sized egg-shaped or spherical particles, largely calcareous. Occupies level

or dune areas. Near Great Salt Lake, Utah, soil derived from the breaking up of lime hardpan, the peculiar and regular shape of its particles resulting from the wearing and polishing action of wind and water. As found in the vicinity of Great Salt Lake soil is of no agricultural value because of its limited extent and its position.

	Acres.
Salt Lake sheet, Utah	1,140

San Gabriel Gravelly Sand.—Light or dark gray gravelly sand 6 feet or more in depth. Occurs in gently, uniformly sloping areas along the areas of river wash. Composed entirely of granitic débris, and contains 25 per cent of granitic gravel, ranging from fine gravel to pebbles 2 or 3 inches in diameter. Especially adapted to vineyards and citrus fruits when irrigated. Always well drained and free from alkali.

	Acres.
San Gabriel sheet, California	30,230

Saugatuck Sand.—Soil to a depth of 9 inches consists of reddish brown, black, and gray sands. Subsoil to a depth of 3 feet or more consists of medium fine sand, containing bands of sand cemented by ferruginous material. These bands of iron crust vary from a fraction of an inch to 1 or more feet in thickness. Occupies slightly depressed areas. The accumulation of iron is probably due to deficient drainage now or at some former period. Truck, peaches, and small fruits do best, and grain fairly well.

	Acres.
Allegan County sheet, Michigan	24,120

Snake River Sand.—Light colored, fine to coarse, loose quartzose sand, sometimes containing gravel, from a few inches to 6 or more feet in depth. Free from alkali. Æolian, lake, and stream deposit. Occurs in ridges and sedimentary terraces along Snake River Valley in western part of Idaho. When irrigated good for fruit, hay, and grain.

	Acres.
Caldwell sheet, Idaho	17,430

Sunnyside Sand.—Medium and fine sand, a few inches to 6 feet in depth. Underlaid by sandy loam of same composition as Yakima sandy loam. Of Æolian origin; occurs in dunes and drifted areas. Adapted to hops, fruit, berries, alfalfa, grass, and truck, but difficult to cultivate on account of drifting. Generally well drained and free from alkali in its uncultivated condition.

	Acres.
Sunnyside sheet, Washington	20,660

Westphalia Sand.—Fine sand or slightly loamy sand, loose and friable when dry, but compacting slightly when wet, underlaid at a depth of from 9 to 16 inches by a fine-grained, loamy sand, somewhat more adhesive. Derived mainly from Cenozoic formations. Occurs on gently sloping valley walls and low, rolling hills. Forest growth oak,

sycamore, tulip, and chestnut. Well adapted to tobacco, corn, potatoes, peaches, strawberries, and small fruits; less suitable for grass and grain.

	Acres.
Prince George County sheet, Maryland	36,190
Salem sheet, New Jersey	4,470

Willis Sand.—Grayish-yellow medium sand, with considerable silt, having an average depth of 10 to 18 inches, but sometimes extending to 36 inches, and underlaid by sticky yellow, red, and gray mottled sand. Scattered iron concretions and rounded quartz pebbles are found in both soil and subsoil. The latter retains water like a clay. Residual soil, and probably derived from some Eocene or later formation. Some areas not well drained. Natural growth, pines, sweet gum, oak, chinquapin, and magnolia. Furnishes some forest grazing. In well-drained areas produces good filler tobacco, truck, and fruit.

	Acres.
Willis sheet, Texas	95,300

Windsor Sand.—Coarse to medium sand containing fine gravel, 8 inches deep, loose and incoherent. Subsoil is practically the same as the soil, with iron crusts typically developed in the Maryland area. Occurs as level plains in the Connecticut Valley and southern Maryland. Generally considered too light and poor for general farming, but is used to some extent for tobacco, peaches, and truck.

	Acres.
Calvert County sheet, Maryland	24,500
Hartford sheet, Connecticut and Massachusetts	29,960
Prince George County sheet, Maryland	37,420
St. Mary County sheet, Maryland	3,450
Salem sheet, New Jersey	18,280

FINE SAND.

Calcasieu Fine Sand.—A fine sand or fine sandy loam, 18 inches in depth, underlaid by 10 inches of loam bearing some silt and sand. Loam grading to mottled clays. Subsoils often carry iron concretions. Fine sand phase is a loose, incoherent gray or dark sand derived in the deposition of the coastal terrace. Fine sandy loam phase is a yellow sand or sandy loam occupying districts near rivers. Type found in low ridges and pine regions. Adapted to truck and orchard crops.

	Acres.
Lake Charles sheet	13,970

Elsinboro Fine Sand.—Fine brown, loamy sand, 8 inches deep, overlying fine yellow loamy sand to depth of 3 feet or more. Low rolling lands. Well drained on slopes, but in small hollows wet and poorly drained. Produces fair crops of corn and oats, medium crops of wheat, good of grass. Specially adapted to late truck.

	Acres.
Salem sheet, New Jersey	11,240

Hanford Fine Sand.—Dark reddish fine sand, micaceous, usually 6 feet or more deep, but often streaked with coarse sedimentary deposits. Sometimes underlaid by sand or fine sandy loam. Occurs in level delta plains and low river terraces. Derived largely from disintegration of granitic rocks. Generally well drained, but at times (in the Hanford area) alkaline. Excellent fruit soil. Used for alfalfa, beets, potatoes, and truck crops.

	Acres.
Hanford sheet, California	51,250
Salinas sheet, California	9,620
Soledad sheet, California	7,420

SANDY LOAM.

Allegan Sandy Loam.—Silty and sandy loams with a depth of 10 to 14 inches, underlaid by light yellowish-gray sandy loam to a depth of 30 inches, under which are found clay, sand, and gravel beds. A few stones are present on surface and scattered through soil and subsoil. Occupies rounded hills with kettle-like intervening depressions and extensive level lowlands bordering water courses. Formed from morainic material and, along water, from glacial débris modified by water action. Peaches, cherries, plums, pears, apples, and small fruits are grown to a considerable extent in some areas, and in others good crops of corn, wheat, grass, rye, and oats.

	Acres.
Allegan County sheet, Michigan	60,020

Boise Sandy Loam.—Light gray, flaky, ashy-textured sandy loam, micaceous, loose, and powdery. From a few inches to 40 or 50 feet in depth. Surface 6 feet often interstratified with loam soil and sand or sandy loam lime hardpan, but in places sandy loam extends to bed rock. Soil rests on coarse gravel and cobbles. Some alkali in local spots in loam subsoil. Usually found on mesas. Lake sediment, probably derived from basalt. Well drained. Adapted to truck, grain, and clover. Where the hardpan is not very thick fruit and alfalfa do well.

	Acres.
Boise sheet, Idaho	39,800
Caldwell sheet, Idaho	56,050

Caldwell Sandy Loam.—Sandy loam with occasional areas of gravel. From few inches to 7 or 8 feet deep, underlaid with coarse gravel and cobbles. Alluvial in origin, but not generally subject to overflow. Contains much black alkali in places. Where not alkaline, good for truck, hay, and grain; preeminently hay and pasture land.

	Acres.
Boise sheet, Idaho	11,780
Caldwell sheet, Idaho	21,320

Cecil Sandy Loam.—Soil is sandy loam of a brownish or yellowish color, 6 to 15 inches deep; subsoil is a clay, containing coarse sand of

reddish or yellowish color, both soil and subsoil containing fragments of quartz, with usually considerable quartz on the surface. High rolling land of Piedmont Plateau, Atlantic Coast States. Partly sedimentary; derived from granite, gneiss, and other metamorphosed rocks. Corn and cotton soils of North Carolina and South Carolina; both bright and dark shipping tobacco in Virginia. Lightest desirable soil for general farming purposes.

	Acres.
Bedford County sheet, Virginia	33,740
Cary sheet, North Carolina	26,090
Clayton sheet, North Carolina	15,560
Cobb County sheet, Georgia	23,170
Covington sheet, Georgia	27,501
Prince Edward sheet, Virginia	91,710
Statesville sheet, North Carolina	148,910

Collington Sandy Loam.—Loose, loamy, brown sand, usually containing considerable coarse sand, 9 to 20 inches deep, derived from weathering of green glauconite sand, underlaid by sticky yellow or greenish-yellow clay-like material with glauconite particles. At 30 to 40 inches greensand, in original purity, occurs. Very productive area, "Forest of Prince George," Maryland. Used for general farming; excellent for small fruits, nurseries, and truck. Good tobacco soil. Contains large amount of potash (2.5 per cent). Same soil is derived from Cretaceous greensand in New Jersey, where it is used for general farming and truck production.

	Acres.
Prince George County sheet, Maryland	23,260
Salem sheet, New Jersey	4,170

Dauphin Sandy Loam.—Sandy shale loam, 6 to 15 inches deep, underlaid by the same material slightly heavier. It is derived from a formation consisting of alternate beds, each 6 or more inches in thickness, of sandstone and shale. It is easily tilled, and is adapted to a wide range of crops, as well as possessing qualities suited for certain kinds of trucking and the growing of wrapper-leaf tobacco.

	Acres.
Lebanon sheet, Pennsylvania	11,220

Deer Flat Sandy Loam.—Fine red micaceous sandy loam, a few inches to 3 feet in depth. Subsoil sandy loam and sand to perhaps 50 or 100 feet. Occurs in higher lying valley areas, and has a generally level surface. Free from alkali in areas mapped. Only small portion cultivated, owing to lack of water for irrigation. Good for truck, grain, clover, and fruit.

	Acres.
Caldwell sheet, Idaho	45,380

Dunkirk Sandy Loam.—Sandy loam 6 to 10 inches deep, underlaid by medium or fine sand. Occurs in lake forelands and is usually

marked by hummocky or undulating topography. In part æolian in origin. Adapted to grapes; is also fair grass land.

	Acres.
Westfield sheet, New York	22,090

Durham Sandy Loam.—Sandy loam 12 inches deep, overlying yellow clay of Piedmont area. Residual soil derived from granites, gneisses, and mica-schist. Ten to 30 per cent of quartz and rock fragments in both soil and subsoil. Excellent cotton soil; good for corn and also for tobacco and truck to some extent.

	Acres.
Alamance County sheet, North Carolina	84,900
Cary sheet, North Carolina	8,090
Clayton sheet, North Carolina	20,950
Prince Edward sheet, Virginia	20,710
Statesville sheet, North Carolina	10,560

Elsinore Sandy Loam.—Light-colored sandy loam, 4 feet in depth, underlaid by coarse sand, grading into gravel. Low, level portions of Sevier Valley, Utah. Derived from river transported material; poorly drained and contains considerable alkali near the surface. At present only adapted to salt-grass meadows.

	Acres.
Sevier Valley sheet, Utah	7,800

Enfield Sandy Loam.—Sand 2 feet in depth, underlaid by Triassic stony loam material; extending as a terrace around the glacial hills of the Connecticut Valley in Connecticut and Massachusetts. Lacustrine deposit over glacial material. Recognized as good soil for the wrapper tobacco of that locality; rather light for general agricultural purposes.

	Acres.
Hartford sheet, Connecticut and Massachusetts	33,150

Fancher Sandy Loam.—Dark-red micaceous sandy loam, 6 feet or more in depth, derived from stream wash from foothills, well drained and free from alkali, containing relatively high percentage of organic matter. Occupies foothill-stream bottoms and sinks. Generally adapted to fruit and vineyards.

	Acres.
Fresno sheet, California	12,832
Hanford sheet, California	19,860

Fresno Sandy Loam.—Sandy loam or very fine sand with properties of sandy loam, 3 feet in depth, white in color, ashy texture, and locally known as "white ash land," underlaid by bluish calcareous alkali hardpan which softens upon application of water. Lower level plains of Fresno County, Cal., derived from degradation of beds of sand, clay, and volcanic ash. Generally contains alkali; when free from such it is an excellent grape and fruit soil.

	Acres.
Fresno sheet, California	69,811
Hanford sheet, California	10,860

Goldsboro Compact Sandy Loam.—Sharp sandy loam, 3 feet or more in depth, forming a firm, compact surface in roads and requiring frequent cultivation of young and tender vegetation to prevent injury from the compact crust which is liable to form. Level plains in Atlantic Coastal Plain. Adapted to cotton and corn.

	Acres.
Craven sheet, North Carolina	25,910
Kinston sheet, North Carolina	26,560
Newbern sheet, North Carolina	4,090
Princeton sheet, North Carolina	11,300

Hartford Sandy Loam.—Sandy loam, 12 inches deep, underlaid by sand to a depth of 3 feet or more. Lacustrine deposits. Level or gently rolling terraces of the Connecticut Valley. Recognized as one of the best soils for the present type of wrapper tobacco of that locality; adapted to truck, but too light and sandy for general farm crops.

	Acres.
Hartford sheet, Connecticut and Massachusetts	54,920

Imperial Sandy Loam.—A fine-grained sandy loam, 3 feet deep, underlaid by clay or loam; formed by deposition of coarsest sediments carried by Colorado River. Surface irregular and covered with dunes. Where free from excess of alkali the soil is adapted to any crop suitable to southern arid regions.

	Acres.
Imperial sheet, California	23,710

Jordan Sandy Loam.—Sandy loam, 2 feet deep; loam to 4 feet; sand to 5 feet, underlaid by clay. Level plains, generally well drained. Derived from lacustrine deposits and river wash. When well drained and free from alkali it is recognized as one of the best of soils for general agricultural purposes and such crops as grain, alfalfa, and fruit.

	Acres.
Salt Lake sheet, Utah	48,620

Maricopa Sandy Loam.—Sandy loam with less than 10 per cent of gravel, 3 feet in depth, underlaid by sandy loam containing layers of calcareous hardpan. Medium elevation in Salt River Valley, Arizona. Adapted to alfalfa, fruit, and grain.

	Acres.
Salt River Valley sheets, Arizona	106,906

Miami Sandy Loam.—Sandy loam, 2 feet in depth, overlying loam. Lies in strips along narrow river and stream bottoms, subject to overflow. Glacial material, reworked by the rivers and streams. Too light for general farm crops, but adapted to market gardening.

	Acres.
Montgomery County sheet, Ohio	4,000

Murrill Sandy Loam.—Grayish-yellow sandy loam, 12 inches, overlying red clay loam that grades into red clay in lower depths. Roll-

ing valleys and lower slopes of Blue Ridge Mountains. Residual soil derived from weathering of sandstone, limestone, and crystalline rocks. Peaches, tomatoes, and small fruits. Formerly bright tobacco.

	Acres.
Bedford County sheet, Virginia	11,910

Oxnard Sandy Loam.—Brown or black, mellow, loose, friable open soil of peculiar woody feel. Four to five feet deep, underlaid by heavy sandy loam or loam. Derived from waste from sandstone and shale hills. Occurs on delta plains. When free from alkali, adapted to lima beans and sugar beets. When alkaline, adapted to sugar beets and barley. Generally well drained, but frequently containing a harmful quantity of alkali salts.

	Acres.
Ventura sheet, California	53,200

Pecos Sandy Loam.—Soil is fine-grained gray sandy loam, 30 inches deep; subsoil is a gray, light loam, slightly heavier than the soil. High, level valley land, derived from lacustrine deposits, well drained and generally free from alkali. Recognized as best general farming land.

	Acres.
Carlsbad sheet, New Mexico	24,776
Roswell sheet, New Mexico	11,540

Penn Sandy Loam.—Soil, sandy loam, 6 to 10 inches; underlaid by same material, slightly heavier. Sandstone fragments to the extent of 5 to 20 per cent generally present. It is derived from the Triassic brown sandstone. The surface varies from rolling to moderately hilly land. It is easily tilled. Crops are of good quality, but of less yield than on limestone soil.

	Acres.
Lebanon sheet, Pennsylvania	40,590

Placentia Sandy Loam.—Sandy loam, 3 feet in depth, underlaid by sandy adobe. Surface material is compact and grades into the sandy adobe. High mesa land, valley lands, and high plains and rolling hills. Remnant of old flood plain subsequently modified by wind action. Well drained and free from alkali. At present adapted to citrus and other fruit when water supply is available; dry-farmed to wheat, barley, and black-eyed beans.

	Acres.
Salinas sheet, California	59,090
San Gabriel sheet, California	48,820
Santa Ana sheet, California	16,857
Soledad sheet, California	14,910
Ventura sheet, California	23,878

Porters Sandy Loam.—Grayish-yellow coarse sandy loam, 10 inches in depth, overlying coarse sandy loam and masses of broken rock. Fragments of rock and huge bowlders scattered on the surface. Occupies

mountain slopes. Is derived from weathering of granite and gneiss and similar rocks. Where slopes are not steep, used to some extent for general farming. Formerly bright tobacco was grown. Adapted to peach orchards and grape culture.

	Acres.
Bedford County sheet, Virginia	46,150

Quinton Sandy Loam.—Brown loamy sand, with a trace of gravel, 8 inches deep, overlying clay mixed with medium sand to a depth of 3 feet or more. Occurs along slopes where the Norfolk sand has been worked over with Alloway clay. Derived from recent geological formations. Good general farming land; some trucking. Fine corn soil.

	Acres.
Salem sheet, New Jersey	16,790

Redfield Sandy Loam.—Red sandy loam 6 feet in depth. Soil derived from disintegration of red sandstone, and is usually well drained. In certain areas soil contains gravel within 3 feet of surface, and this gravel increases in amount and size in lower depths. Valley floor, sloping gently toward the mountains, or as upper bench land. Adapted to alfalfa and grain when so situated that irrigation is possible.

	Acres.
Sevier Valley sheet, Utah	44,200

Roswell Sandy Loam.—Heavy gray sandy loam 12 inches deep; subsoil is a light loam underlaid by clay at a depth of 5 feet. Level second-bottom land derived from lacustrine deposits, poorly drained, often containing alkali. Recognized as best farming land.

	Acres.
Roswell sheet, New Mexico	9,090

Salt Lake Sandy Loam.—Sandy loam 2 feet deep, underlaid by fine sand. Level plains, recent lake bottoms. Soil is poorly drained and bare of vegetation, containing an excess of alkali. For these reasons it has no present agricultural value.

	Acres.
Weber County sheet, Utah	49,900

San Joaquin Sandy Loam.—Reddish light sandy loam 3 feet in depth, frequently hard and compact, underlaid by red sandstone hardpan. Along foothill streams hardpan is absent, the sandy loam extending to a depth of 6 feet or more. Generally occupies sloping valley plains. Soil is derived from disintegration of red sandstone rock, well drained, free from alkali, and frequently covered with hog-wallow mounds. Adapted to grain crops, and where hardpan is more than 3 feet from the surface to fruits and vineyards.

	Acres.
Fresno sheet, California	74,547

Santiago Sandy Loam.—Sandy loam 3 feet deep, underlaid by sand to

5½ feet, which is in turn underlaid by sand and gravel. Over a considerable area the gravel comes to the surface and increases in size and amount in the lower depths. Lower delta plains of the foothill streams in Orange County, Cal. Dry-farmed to wheat and barley, and under irrigation at present adapted to fruits of that locality.

	Acres.
Santa Ana sheet, California	17,100

Sassafras Sandy Loam.—Occurs as low, nearly level terraces along tide-water estuaries in northern Atlantic coast region. Rarely rises more than 35 feet above sea level. The soil is a brown sandy loam, containing some fine gravel. It rests upon a yellow loam, somewhat sandy, which in turn is frequently underlaid by medium yellow sand or gravel. It is an easily tilled, well-drained soil, producing fair general farm crops. It is especially adapted to sugar corn, peas, tomatoes, etc., for canning purposes.

	Acres.
Calvert County sheet, Maryland	10,900
Prince George County sheet, Maryland	17,500
St. Mary County sheet, Maryland	4,830

Volusia Sandy Loam.—The soil is a brown or yellow sandy loam 6 to 10 inches deep, resting upon a fine orange sand 3 feet or more in depth; sometimes contains fragments of shale. It is a very productive soil for corn, oats, and potatoes—particularly for the latter, of which large yields are reported. Wheat, however, does not do well and seldom yields even a fair crop. Used for dairying. Small apple orchards numerous.

	Acres.
Westfield sheet, New York	69,940

Worsham Sandy Loam.—Gray sandy loam, generally fine, and of soft, whitish appearance, having a depth of 12 to 14 inches. Subsoil yellowish, sticky, sandy loam or loam to a stiff, plastic, yellow clay, mottled with white. Residual origin from granites, gneisses, and schists. Originally post-oak land. Clover, grasses, hay, and pasturage.

	Acres.
Prince Edward sheet, Virginia	8,520

Yakima Sandy Loam.—Grayish, fine sandy loam, 6 feet or more in depth, with occasional strata of fine sand and bands of volcanic ash in surface 6 feet. Micaceous. Occupies hills, slopes, and level valley floors. Derived from sediments of Lake John Day. Adapted to hops, fruit, and hay crops. Usually contains small percentage of alkali in subsoil, and where water is near surface becomes badly alkaline.

	Acres.
Yakima sheet, Washington	34,450
Sunnyside sheet, Washington	115,130

Yazoo Sandy Loam.—Fine to very fine yellow sand, 0 to 6 inches; brown loamy sand, 6 to 12 inches; fine yellow sand, 12 to 40 inches; or,

near the margins of areas, underlaid by waxy clay below 12 inches. Occupies low, flat ridges forming front lands near stream courses in the Yazoo River Delta, Mississippi. Chief product is cotton, but soil is suited to truck and market-garden crops.

	Acres.
Yazoo sheet, Mississippi	15,170
Mayersville sheet, Mississippi	11,500

FINE SANDY LOAM.

Allegan Fine Sandy Loam.—Soil to the depth of 10 inches consists of chocolate-brown sandy and silty loam, underlaid by a light-brown fine sand. A few stones are present on the surface and mixed with the soil. Rolling country and flat lands bordering swamps. Peaches, cherries, plums, apples, pears, and small fruits are successfully grown, as well as corn, wheat, grass, and pasture.

	Acres.
Allegan County sheet, Michigan	13,260

Ayden Fine Sandy Loam.—Pale-yellow fine sandy loam, 18 to 36 inches deep, underlaid by heavy, reddish-yellow fine sandy loam, or loam which becomes heavier with depth. Surface slightly undulating. Sedimentary origin. Found in Coastal Plain at elevation of 50 to 75 feet. Good type of bright tobacco and cotton land, and yields fair crops of corn.

	Acres.
Craven sheet, North Carolina	33,000

Calcasieu Fine Sandy Loam.—A light gray, grading to ashy colored fine sandy loam, carrying a relatively high per cent of silt. Surface soil 14 inches deep, subsoil 10 inches of loam underlaid by clays, gen erally mottled. Subsoils carry iron nodules. Type found in areas of abrupt depression. Sand mounds often present. Origin of type, coastal swamp. Texture due to local erosion. No special agricultural value.

	Acres.
Lake Charles sheet, Louisiana	5,500

Fresno Fine Sandy Loam.—Fine sand having the properties of a sandy loam to a depth of 3 feet, grading into a coarse sand. Coastal and delta plains of rivers; occurring in California and in Weber County, Utah. Well adapted to such crops as alfalfa, lima beans, and grain, but not so well adapted to fruit, except when well drained. A fine English-walnut soil in southern California.

	Acres.
Salinas sheet, California	11,850
San Gabriel sheet, California	10,790
Santa Ana sheet, California	11,552
Soledad sheet, California	6,480
Ventura sheet, California	12,896
Weber County sheet, Utah	86,400

Gila Fine Sandy Loam.—Fine sandy loam or very fine sand 6 feet or more in depth, derived from river deposits subsequently modified by wind action. Occupies low bluffs and plains. Adapted to alfalfa and grain crops.

	Acres.
Salt River Valley sheet, Arizona	18,578

Hanford Fine Sandy Loam.—Dark-colored fine sandy loam, micaceous, 4 feet in depth, underlaid usually by 2 feet or more of loam or sandy clay. Occurs in level delta plains, and is derived largely from the disintegration of granitic rocks. Good corn and grain land; also valued for vineyards. Generally free from alkali.

	Acres.
Hanford sheet, California	30,010

Lake Charles Fine Sandy Loam.—A dark-brown or black sandy loam, merging sometimes to light gray, 14 inches in depth; subsoil a loam which grades at 10 inches into a clay loam carrying some silt. Under the clay loam occurs a mottled clay subsoil often carrying iron or lime concretions. Found on the higher elevations and marked by sand hummocks. Owes its texture to local erosion and admixture of sand from hummock areas. Originally a coastal deposit. Adapted to farming crops requiring light soils and medium drainage.

	Acres.
Lake Charles sheet, Louisiana	53,300

Norfolk Fine Sandy Loam.—Fine sandy loam, 12 or more inches deep, underlaid by light, friable clay. Level plains in Coastal Plain region, some areas along rivers subject to overflow. Good soil for late and heavy truck, cotton, and corn.

	Acres.
Craven sheet, North Carolina	148,640
Kinston sheet, North Carolina	36,100
Newbern sheet, North Carolina	55,560
Willis sheet, Texas	11,880

Podunk Fine Sandy Loam.—Fine sandy loam, 12 inches deep, underlaid by fine sand. Level terrace of the Connecticut Valley. Lacustrine deposit. Rather light for general farm purposes, but well adapted to present type of broad leaf wrapper tobacco.

	Acres.
Hartford sheet, Connecticut and Massachusetts	3,460

LOAM.

Boise Loam.—Red or yellow loam from 6 inches to several feet in depth, underlaid with alternating strata of sandy loam and sand, the latter often being cemented by calcium carbonate into a hardpan. Soil particles in the upper stratum of virgin soil also usually cemented together, but not into a compact mass. Surface is usually covered with a coating of sandy loam, varying in depth and having the texture

of the Boise sandy loam. Occurs on mesa plains, and is derived from lake sediments. Often alkaline. When subsoil is broken up, is good for fruit, grain, and alfalfa.

	Acres.
Boise sheet, Idaho	47,560
Caldwell sheet, Idaho	14,400

Calcasieu Loam.—Dark-brown, brownish-gray, or gray silty loam, 6 to 16 inches in depth, grading into clay loam 8 inches deep, beneath which are mottled clays. Origin of soil, coastal deposit. Found in poorly drained areas of depression containing scattered sand mounds. Is an excellent rice soil.

	Acres.
Lake Charles sheet, Louisiana	51,280

Caldwell Loam.—Loamy soil 2 to 6 feet in depth, sometimes overlying sandy loam or sand, but often resting directly on coarse gravel. Not well drained. Usually free from alkali. Alluvial soil. Hay and pasture land.

	Acres.
Caldwell sheet, Idaho	1,500

Cecil Loam.—Soil is a loam, or heavy sandy loam, of brown or yellowish color, 10 inches deep; heavy loam or clay loam subsoil of reddish color, both soil and subsoil containing fragments of quartz, with usually considerable quartz on the surface. High rolling land. Derived from granite, gneiss, and other metamorphosed rocks. Occurs in Piedmont Plateau, Atlantic Coast States. Recognized as good soil for general farming purposes, but requires careful treatment. Adapted to wheat, corn, and grass. Used extensively for tomatoes.

	Acres.
Cecil County sheet, Maryland	52,600
Harford County sheet, Maryland	110,320

Cecil Mica Loam.—Brown loam, 12 inches deep, underlaid by clay loam, both soil and subsoil consisting largely of small fragments of muscovite mica. Rolling land of Piedmont Plateau. Derived from decomposition of highly crystalline rocks; typically developed in Cecil County, Md., and Lancaster County, Pa. Recognized as good land for general farming purposes.

	Acres.
Cecil County sheet, Maryland	10,000
Harford County sheet, Maryland	39,930
Lancaster County sheet, Pennsylvania	10,000
Prince George County sheet, Maryland	600

Clarksville Loam.—Rich, dark-brown, silty loam, 12 inches deep, underlaid by brown loam, heavier in texture, to a depth of 3 to 6 or more feet. Occurs as well-marked bottom lands along rivers and their larger tributaries. Generally well drained, but subject to occasional

overflow. Alluvial deposit laid down by rivers along which it occurs. Fine land for corn and hay, but at present little used for other crops.

	Acres.
Clarksville sheet, Tennessee	17,090

Conestoga Loam.—Brown loam, 12 inches deep, underlaid by light clay loam to depth of 30 inches, grading into decomposed schist. Rolling valley land. Derived from decomposition of limestone schist; has a greasy or soapy feel when rubbed between the fingers. Recognized as one of the best of soils for general agricultural purposes.

	Acres.
Lancaster County sheet, Pennsylvania	51,000

Conowingo Barrens.—Loam 3 feet or more in depth, frequently filled with fragments of broken rock increasing in size and amount in lower depths; often there is no soil covering over the broken fragments of rock. Rolling upland of Piedmont Plateau. Derived from decomposition of serpentine and rocks of similar nature. Generally unproductive and frequently worthless for agricultural purposes, due to slight depth of soil covering and usually ascribed to preponderance of magnesia.

	Acres.
Cecil County sheet, Maryland	2,000
Harford County sheet, Maryland	3,280

Elmwood Loam.—Dark-brown fine sandy loam, 2 feet in depth, overlying close, poorly drained clay. Level terraces along Connecticut River. Lacustrine deposit. Has very little present agricultural value on account of compact nature and poor underdrainage.

	Acres.
Allegan County sheet, Michigan	3,810
Hartford sheet, Connecticut and Massachusetts	11,710

Glenwood Loam.—Loam 4 feet deep, underlaid by clay. Level valley floor. Soil contains considerable alkali and drainage is often poor, but when drained and free from alkali it is excellent for general farming purposes.

	Acres.
Sevier Valley sheet, Utah	12,100

Hagerstown Loam.—Brown or yellow loam 12 inches deep, yellow clay loam to 24 inches, underlaid by stiff, tenacious red clay. Rolling valley land. Found in the great valley of the Appalachian system. Derived from weathering of pure massive limestone. Typical corn land of central Pennsylvania, Maryland, and the Shenandoah Valley of Virginia. One of the best types of general farming lands in the Eastern States. Produces corn, tobacco, wheat, and grass.

	Acres.
Bedford County sheet, Virginia	40,520
Lancaster County sheet, Pennsylvania	45,000
Lebanon sheet, Pennsylvania	93,110

Imperial Loam.—A fine-grained, sticky loam without grit or sand, on an average 5 feet deep, underlaid by clay or clay loam. A very fertile soil, but frequently contains an excess of alkali salts. Drainage of this soil is costly and difficult on account of its close grain. When free from akali it is adapted to most of the crops suited to the climate, but as it is likely to pack, annual crops or cultivated crops will prove most profitable.

	Acres.
Imperial sheet, California	30,410

Jordan Loam.—Loam 3 feet deep, underlaid by stiff, tenacious clay. Level low-lying plains. Origin, lacustrine, or river deposits, in Salt Lake and Sevier counties, Utah. Generally contains alkali. When free from alkali and well drained this soil is good for alfalfa and grain crops.

	Acres.
Salt Lake sheet, Utah	41,900
Weber County sheet, Utah	15,400

Lake Charles Loam.—Dark brown, black, or bluish-black loam, carrying high per cent of organic material. At 14 inches subsoil of clay loam appears, underlaid by mottled clay. Origin, local swamp areas into which fine loam has drifted. A heavy soil, difficult to till. Properly cultivated makes an excellent rice land. A probable celery type.

	Acres.
Lake Charles sheet, Louisiana	1,770

Lintonia Loam.—Brown, silty loam, 0 to 9 inches, yellow silt, 9 to 36 inches, underlaid by drab clay at a depth of 3 or 4 feet. Talus slope in front of bluff. Rarely inundated, but subject to addition of material from bluff during winter rains. Cotton produces well. Adapted also to market gardening and fruit culture.

	Acres.
Yazoo sheet, Mississippi	3,060

Maricopa Loam.—Reddish loam, 3 to 6 feet in depth, underlaid by loam containing layers of calcareous hardpan. Lower valley land. Colluvial soil, derived from finer waste of mountain slopes. Adapted to alfalfa and grain.

	Acres.
Salt River Valley sheets, Arizona	20,650

Miami Loam.—Black loam 12 inches deep, resting on some slightly heavier material. Level bottom lands, subject to overflow. Glacial material reworked by rivers and streams. Fine corn land, but the growth is too rank for either wheat or grass, as the wheat is liable to lodge and the grass to be choked by weeds.

	Acres.
Montgomery County sheet, Ohio	14,000

Norfolk Loam.—Fine-grained sandy loam, 12 inches deep; reddish-yellow sandy loam, 12 to 30 inches, underlaid by red sand. Gently

rolling land or flat tops of hills. Good land for small fruits, heavy truck, and tobacco.

	Acres.
Calvert County sheet, Maryland	5,220
Prince George County sheet, Maryland	9,660
St. Mary County sheet, Maryland	8,500

Oxnard Loam.—Heavy, sticky brown or black loam, underlaid at 3 to 4 feet by a compact and heavier phase of the same soil. Derived from waste from shales and sandstones, and laid down on delta plains. Adapted to barley and sugar beets. When alkaline adapted to same crops. Frequently needs draining.

	Acres.
Ventura sheet, California	6,829

Pecos Gypsum.—Sandy loam or light loam soil, underlaid by soft saccharoidal gypsum at a depth of 2 feet. Gypsum is often present at the surface. Level bench land. Derived from disintegration of gypsum deposits, and possesses remarkable power of transmitting seepage waters by capillarity and gravitational flow. With high salt content of irrigation water it is not desirable land for agricultural purposes.

	Acres.
Carlsbad sheet, New Mexico	11,628

Penn Loam.—Is a dark-red loam, 8 to 12 inches, underlaid by red clay loam subsoil. Occasionally contains 5 to 20 per cent of sandstone fragments. Surface gently rolling. Derived from fine-grained brown or red sandstone (Triassic). The drainage is fair, but plowing in beds is generally practiced to assist the natural drainage. It is considered almost equal to associated limestone soils in fertility.

	Acres.
Lebanon sheet, Pennsylvania	26,890

Porter's Black Loam.—Rich dark loam, 15 inches deep, mixed with rounded and angular fragments of rock, often several feet in diameter. Subsoil is a yellowish brown or reddish clay loam, containing a large percentage of rocks. Steep slopes of higher mountains. Residual soil derived from granite, gneiss, and similar rocks. Fertile soil, but slopes are too steep and stony to admit of extensive cultivation for general farm crops. Especially adapted to apples.

	Acres.
Bedford County sheet, Virginia	8,270

Redfield Loam.—Vermillion-colored loam, 5 feet deep, underlaid by clay to a considerable depth. Poorly drained soil, containing large quantities of alkali. Level valley floor. Excellent land for general farming purposes when drained and free from alkali.

	Acres.
Sevier Valley sheet, Utah	14,100

Roswell Loam.—Loam, 4 feet deep, underlaid by clay loam and clay. Level, low bench land. Lacustrine deposit. Soil is naturally poorly

drained and contains alkali, but when well drained and free from alkali it is recognized as good soil for general agricultural crops.

	Acres.
Roswell sheet, New Mexico	2,730

Salt Lake Loam.—Loam, 2 feet deep, underlaid by sandy loam. Level plains, representing recent lake bottom, poorly drained, containing excessive amounts of alkali. Soil is not adapted to agricultural crops at present on account of low-lying position, imperfect drainage, and high salt content.

	Acres.
Weber County sheet, Utah	9,600

Santiago Loam.—Red loam, 3 feet deep; sandy loam to 4 feet, underlaid by gravelly sandy loam. Harsh, compact soil washed from foothills by the streams; occurring along margin of coastal plain near foothills in southern California. Considered unproductive soil, and at present little used for agricultural purposes.

	Acres.
Santa Ana sheet, California	1,830

Sassafras Loam.—Brown loam, 10 inches deep, underlaid by heavy, yellow loam subsoil. Gently rolling upland in Cecil and Kent counties, Md., and level terraces in more southern counties of eastern shore; level or gently rolling terraces and level uplands in southern Maryland. Good land for general agricultural purposes. Terrace levels in New Jersey, where it attains its greatest value as a farm land, largely through a good system of cultivation. In New Jersey produces 25 to 35 bushels of wheat, 1 to 2 tons of hay, and 50 to 70 bushels of corn per acre. In Cecil, Kent, and Harford counties, Md., Sassafras loam produces 20 to 25 bushels of wheat, 40 to 60 bushels of corn, and about 1 ton of hay per acre. In Prince George, Calvert, and St. Mary counties it produces 12 to 18 bushels of wheat, 25 to 40 bushels of corn, and little hay; also produces fair tobacco. The differences of production depend largely on the method of cultivation.

	Acres.
Calvert County sheet, Maryland	8,850
Cecil County sheet, Maryland	50,500
Harford County sheet, Maryland	29,810
Kent County sheet, Maryland	59,140
Prince George County sheet, Maryland	9,090
Salem sheet, New Jersey	64,930
St. Mary County sheet, Maryland	16,200

Volusia Loam.—A brown or black loam, 6 to 10 inches deep, resting on a yellow silty loam containing shale fragments and having a depth of 3 feet or more, in turn underlaid by shale rock. The surface is strewn with shale and slate fragments and occasionally an erratic glacial bowlder. Occurs typically developed upon heavy rolling uplands, but

extends down into the foreland along the lake. Derived from morainic material. Crops, wheat, corn, and at lower elevations grapes.

	Acres.
Westfield sheet, New York	10,030

Yazoo Loam.—Yellow or brown silt 0 to 6 inches, drab clay 6 to 40 inches. Margins of frontlands in Yazoo River Delta. Represents higher lying areas of fine sediment deposited by inundations. Strong cotton soil, producing 1 bale per acre. In need of drainage.

	Acres.
Mayersville sheet, Mississippi	4,240
Yazoo sheet, Mississippi	11,840

SHALE LOAM.

Cardiff Slate Loam.—Heavy yellowish-brown loam, having a depth of 8 or 10 inches, underlaid by heavy yellow silty clay to a depth of 3 feet or more. Both soil and subsoil contain from 15 to 40 per cent of partially decomposed slate fragments. Formation occurs on prominent narrow ridges. Derived from the decomposition and breaking up of fine-grained slate. The presence of the slate fragments in the soil makes quite friable what would otherwise be a refractory clay. Much of the area is forested with oak, chestnut, and other trees. Produces fair crops of corn, wheat, rye, oats, and grass.

	Acres.
Harford County sheet, Maryland	1,690

Dunkirk Shale Loam.—Brown or gray loam, about 7 inches deep, underlaid by mottled clay to a depth of 1 to 3 feet. Surface in most places covered with shale fragments from 1 to 4 inches in diameter. Located on escarpment and the steeper slopes. Residual soil derived from shale. Generally covered with timber and underbrush. Less steep positions under vineyards.

	Acres.
Westfield sheet, New York	21,860

Hagerstown Shale Loam.—Loam 12 inches deep, containing 20 to 60 per cent of fragments of shale, resting upon a mass of broken shale. Ridges in limestone valley. Thin, dry soil, derived from disintegration of shales, requiring very thorough cultivation, but when so cultivated adapted fairly well to general agricultural purposes.

	Acres.
Bedford County sheet, Virginia	25,370
Lancaster County sheet, Pennsylvania	15,000
Lebanon sheet, Pennsylvania	142,210

Salinas Shale Loam.—Very light chalklike loam, 5 to 6 feet in depth, grading into loam of texture of Oxnard loam. Light, friable, and easily cultivated; sometimes contains large percentage light siliceous gravel, derived from the beds of bituminous shale of Miocene age. Occurs on level, gently sloping plains near mountains. Always well

drained and free from alkali. Adapted to Lady Washington and black-eyed beans and barley.

	Acres.
Soledad sheet, California	13,730
Ventura sheet, California	2,544

SILT LOAM.

Alamance Silt Loam.—Yellowish-gray silt loam, 8 inches deep, underlaid by heavy yellow clay. Clay content increases in lower depths. Both soil and subsoil contain fragments of broken rock. Occupies rolling lands. Residual soil derived from decomposition of highly metamorphosed crystalline rocks. Area largely forested. Fair land for cotton, corn, and wheat.

	Acres.
Alamance County sheet, North Carolina	7,860

Clarksville Silt Loam.—Yellowish-gray silt loam, 7 inches in depth, underlaid by brownish-yellow, heavy silt loam to a depth of 24 inches, overlying heavy red clay loam 3 feet or more in depth. Deep subsoil often contains fragments of chert. Typically developed in the rolling country along Cumberland and Red rivers. Residual soil derived from St. Louis limestone. Well drained and originally in heavy forest, much of which still remains. Naturally strong, fertile soil, but needs careful treatment to maintain fertility. Best soil for producing finest quality of heavy export tobacco of Clarksville district; also well adapted to corn, wheat, and grass.

	Acres.
Clarksville sheet, Tennessee	233,410

Glendale Loess.—Silt 6 feet or more in depth, typical loess texture. Level plain, forming low divide between Salt River and Agua Fria River, Arizona. Formed by wash from Cave Creek. Generally well drained and free from alkali. Adapted to grain and alfalfa; lighter phases to fruit growing.

	Acres.
Salt River Valley sheet, Arizona	52,040

Leonardtown Loam.—Yellow silty loam, closely resembling loess, 9 inches deep, underlaid by red and mottled clay loam with peculiar interlocking clay lenses and pockets of sand. Slightly rolling upland. Good soil for general farming, wheat, and grass land. Much of the area is waste land or grown up in white oak and pine forests, and some of the more level portions need underdrainage. This soil is deficient in organic matter and lime.

	Acres.
Calvert County sheet, Maryland	7,950
Prince George County sheet, Maryland	45,770
St. Mary County sheet, Maryland	95,500

Memphis Silt Loam.—Fine yellow or brown silt loam, 0 to 8 inches; chocolate-brown loam 8 to 40 inches, underlaid at from 2 to 6 feet by yellow silt of loess formation. Uplands of Mississippi. Subject to

serious erosion. Only about 20 per cent of total area cultivated. Largely forested to oak, hickory, and beech. Divided topograhically into two regions: The Cane Hills, which are steep sided and narrow topped, and the Flat Hills, which are more plateau-like and cultivated to a greater extent than the Cane Hills. Cotton three-eighths to one-half bale per acre.

	Acres.
Yazoo sheet, Mississippi	140,090

Oxnard Silt Loam.—Brown, friable silt loam, 6 feet or more in depth, derived from finer sediments of streams draining sandstone areas, mixed with particles of organic matter. Occurs on leval delta plains. Adapted to lima beans, corn, and barley without irrigation, and to lima beans, walnuts, and deciduous and citrus fruits when irrigated. Well drained and free from alkali salts.

	Acres.
Ventura sheet, California	5,320

Santiago Silt Loam.—Silt loam is a dense, heavy soil resembling adobe, 2 feet in depth, very sticky when wet, underlaid by sand, fine sand, or fine sandy loam. Lower delta plains and river terraces. Derivation from modern alluvium, often being deposited at present during flood season. When well drained and free from alkali this soil is adapted to fruit, celery, and sugar beets. It is dry farmed to wheat to some extent, and as occurring in the Salinas Valley is considered a most valuable soil.

	Acres.
Salinas sheet, California	3,910
San Gabriel sheet, California	5,220
Santa Ana sheet, California	14,349
Soledad sheet, California	10,210

Selma Heavy Silt Loam.—Heavy silt loam, 20 inches or more in depth, underlaid by a stiff, mottled clay. Low-lying level tracts in Coastal Plain region, North Carolina. Natural drainage is poor, and for this reason the soil is unproductive, but when drained it is good cotton and grass land.

	Acres.
Clayton sheet, North Carolina	4,650
Kinston sheet, North Carolina	350
Newbern sheet, North Carolina	3,420
Princeton sheet, North Carolina	13,980

Selma Silt Loam.—Occurs in large areas in the Atlantic Coastal Plain. The surface is generally rolling, with numerous fine sandy knolls and ridges. It is well drained. The soil consists of about 18 inches of silt mixed with fine sand, resting on a silty loam subsoil. The sandy knolls and ridges are especially suited to the production of

bright tobacco, while the lower-lying siltier portions produce cotton, corn, tobacco, and truck.

	Acres.
Clayton sheet, North Carolina	11,780
Kinston sheet, North Carolina	25,440
Princeton sheet, North Carolina	75,450

CLAY LOAM.

Clarksville Clay Loam.—Heavy reddish-brown loam, 8 inches deep, underlaid by heavy red clay loam to depth of 3 feet or more, clay content increasing at lower depths. Typically developed in northern portion of Montgomery County, Tenn., along Kentucky boundary line. Gently undulating country, usually well drained. Deep residual soil derived from decomposition of marine limestone of St. Louis group. On account of scarcity of timber at time of discovery has always been known as the "Barrens." Strong, fertile soil, considered best general farm land of the locality. Tobacco of the export variety produces heavy yield, but not of superior quality.

	Acres.
Clarksville sheet, Tennessee	27,460

Davie Clay Loam.—Pale yellow loam, 6 inches in depth, underlaid by pale yellow friable clay which becomes red and heavier in texture in lower depths. Soil and subsoil contain small amounts of broken quartz fragments. Level or gently rolling uplands. Derived from decomposition of talc schists and similar rocks. Area mostly forested. Produces fair crops of wheat, corn, and tobacco.

	Acres.
Statesville sheet, North Carolina	3,370

Hagerstown Clay Loam.—Heavy reddish clay loam 24 inches deep, overlying stiff, tenacious red clay. Rolling valley land. Derived from weathering of pure massive limestone. Recognized as one of the strongest soils for general agricultural purposes. Well known for large crops of wheat and corn.

	Acres.
Lancaster County sheet, Pennsylvania	21,000

Iredell Clay Loam.—Dark-brown loam 8 inches in depth, containing small rounded iron concretions on the surface. Subsoil is stiff, impervious yellow clay 24 inches deep, underlaid by soft decomposed rock. Level or slightly rolling areas. Residual soil derived from diorite and similar eruptive rocks. Known as "black-jack" or "beeswax" land. In level areas inclined to be swampy on account of impervious nature of clay subsoils. Considered poor cotton, corn, and wheat land.

	Acres.
Alamance County sheet, North Carolina	18,760
Prince Edward sheet, Virginia	103,070
Statesville sheet, North Carolina	22,340

Lacasine Clay Loam.—A heavy brown or black clay loam 20 inches deep, grading into mottled clay—blue generally predominating. Subsoil contains some silt, iron nodules, and sometimes lime concretions. Found in depressions in large swamp areas free from hummocks. A heavy soil, difficult of tilth and poorly drained, but with lasting properties. Phase has no agricultural importance.

	Acres.
Lake Charles sheet, Louisiana	3,470

Lickdale Clay Loam.—Is a silty loam, 6 to 10 inches in depth, underlaid by a mottled yellow clay. It occurs in small extent at the foot of the Blue Ridge Mountains, and is derived from the wash of the mountains and the adjacent shale formations. Sometimes fragments of gray sandstones are present to the extent of from 5 to 20 per cent. It is low-lying, flat land, and poorly drained. Naturally it is very refractory and is suited only to grass and pasture, but when artificially drained it becomes mellow and produces quite a wide range of crops.

	Acres.
Lebanon sheet, Pennsylvania	3,920

Maricopa Clay Loam.—Stiff reddish clay loam 6 feet or more in depth. Low valley land. Colluvial soil, heaviest products of the waste from the mountain slopes. Adapted to grain crops, but rather heavy and compact for alfalfa.

	Acres.
Salt River Valley sheet, Arizona	8,713

Miami Black Clay Loam.—Black clay loam, 12 inches deep, underlaid by same material, which is rather heavier and more tenacious, occupying slight depressions in uplands. Glacial origin. Areas naturally poorly drained and formerly swamps, in which water stood during the greater part of the year. Recently they have been thoroughly drained and are now considered as productive as the other upland soils for general farm purposes.

	Acres.
Montgomery County sheet, Ohio	18,000

Miami Clay Loam.—Light-colored loam, 12 inches deep, underlaid by a tenacious clay loam, which in turn is underlaid by bowlder clay at a depth of 5 feet. Level plains, except adjacent to the streams. Glacial origin. The surface of the country was formerly covered by bowlders, which have largely been removed. One of the best of soils for general agricultural purposes.

	Acres.
Montgomery County sheet, Ohio	240,000

Murrill Clay Loam.—Yellowish-brown clay loam, 10 inches deep, overlying yellow clay loam, increasing in clay content in lower depths. Both soil and subsoil often contain small fragments of shale and chert. Derived from weathering of shales and cherty limestone. Rolling

valley lands. Fertile soil; produces good crops of wheat. corn, grass, dark manufacturing tobacco, and apples.

	Acres.
Bedford County sheet, Virginia	15,720

Redfield Clay Loam.—Clay 5 feet in depth, underlaid by sand. Clay is quite tenacious and difficult to till. Poorly drained soil, containing considerable alkali. Low and level valley land. Of little agricultural value except as meadow land.

	Acres.
Sevier Valley sheet, Utah	3,800

Susquehanna Clay Loam.—Sandy loam or sand about 10 inches deep, underlaid by heavy mottled clay, subsoil identical with Susquehanna clay. Occupies hills, slopes, and valleys. Adapted to grain and grass crops. Considerable areas yet in oak and pine forest.

	Acres.
Prince George County sheet, Maryland	16,850

CLAY.

Allegan Black Clay.—Black clay loam 10 inches deep. Subsoil is a heavy, impervious blue clay to a depth of 3 feet or more. A few bowlders are found on the surface and mixed with the soil and subsoil. Occupies slight depressions in clay areas and lies along stream courses. On account of poor drainage swampy conditions often exist. Naturally soil is wet and contains considerable partially decomposed vegetable matter. When well drained, considered excellent soil for corn, wheat, grass, and pasture and all kinds of truck crops. In Allegan County recognized as one of the finest soils for sugar beets.

	Acres.
Allegan County sheet, Michigan	12,460

Allegan Clay.—Heavy clay loam of a yellowish color, having a depth of from 6 to 12 inches, underlaid by yellow, drab, blue, or red clay to a depth of 3 feet or more. A few scattered stones and bowlders on surface and mixed through both soil and subsoil. Rolling land derived from superficial weathering of glacial till. For best results artificial drainage is necessary. When drained, a good soil for wheat, corn, and grass, and especially adapted to grazing and dairying.

	Acres.
Allegan County sheet, Michigan	107,850

Alloway Clay.—Red or gray clay loam 6 inches deep, containing some gravel, underlaid by a mottled yellow and gray sticky clay to a depth of 3 feet or more. Rolling upland. Derived from Miocene—recent sediments. Good grass and wheat lands. Produces fine apples.

	Acres.
Salem sheet, New Jersey	10,580

Cecil Clay.—Tenacious clay soil of reddish color, 6 inches deep; stiff, tenacious clay subsoil, of red color, both soil and subsoil con-

taining quartz and fragments of undecomposed rock. Occasional rock areas and isolated bowlders, or "niggerheads." High, rolling land. Derived from gabbro and other eruptive rocks—Piedmont Plateau, Atlantic Coast States. Recognized as strongest soil of this region for general farming purposes. Adapted to grass, wheat, and corn in Maryland and Pennsylvania; export tobacco and wheat in Virginia; and to corn, wheat, and cotton in the Carolinas.

	Acres.
Alamance County sheet, North Carolina	101,370
Bedford County sheet, Virginia	142,730
Cary sheet, North Carolina	2,960
Cecil County sheet, Maryland	12,500
Clayton sheet, North Carolina	2,030
Cobb County sheet, Georgia	166,130
Covington sheet, Georgia	99,930
Harford County sheet, Maryland	39,870
Lebanon sheet, Pennsylvania	22,500
Prince Edward sheet, Virginia	31,590
Statesville sheet, North Carolina	289,590

Conowingo Clay.—Stiff, tenacious red clay, 3 feet or more in depth. High rolling land of Piedmont Plateau. Derived from decomposition of serpentine, steatite, and similar rocks, typically developed in Cecil County, Md. Strong and productive soil for general agricultural purposes. The difference in the texture of the soil and the agricultural value between this and the Conowingo barrens has never been satisfactorily explained.

	Acres.
Cecil County sheet, Maryland	3,000
Harford County sheet, Maryland	6,510

Dunkirk Clay.—Soil is clay loam 6 to 12 inches in depth, underlaid by a tenacious mottled clay, beneath which at a depth of 4 to 10 feet occurs the typical bowlder clay. Near ancient beach lines; sometimes underlaid by gravel. Found upon lake foreland and in upland valleys. Derived from deposition in quiet water. Some areas badly drained. Adapted to grapes, grain, and grass.

	Acres.
Westfield sheet, New York	23,490

Elkton Clay.—Brown loam 9 inches deep; subsoil is heavy mottled yellow and gray clay loam containing some silt. It is of a dry nature, rather than plastic. Flat terrace occurring in lowest Columbia terrace in Cecil and Kent counties, Md., and in similar positions in other areas along Atlantic Coastal Plains. Recognized as good land for general farming purposes when well drained; frequently needs artificial drainage.

	Acres.
Cecil County sheet, Maryland	7,000
Kent County sheet, Maryland	27,840
Harford County sheet, Maryland	11,370
Prince George County sheet, Maryland	1,450
Salem sheet, New Jersey	11,240

Guthrie Clay.—Soil is a light gray or grayish white fine silty loam, having a depth of 7 inches, underlaid by a heavy silty clay, plastic and impervious. The subsoil varies in color from a gray to drab, mottled with yellowish iron stains. Occupies low flat areas on the uplands. Soil is derived from decomposition of marine limestone of St. Louis group. On account of low, wet condition, it is of little agricultural value unless thoroughly drained. In favorable seasons some corn and tobacco are grown. Area largely covered by hickory, sweet gum, and oak.

	Acres.
Clarksville sheet, Tennessee	5,800

Hagerstown Clay.—Heavy red loam 12 inches deep, underlaid by stiff, tenacious red clay. Rolling valley land. Derived from weathering of pure massive limestone—Central Pennsylvania and Shenandoah Valley of Maryland and Virginia. Recognized as one of the strongest soils for general agricultural purposes.

	Acres.
Bedford County sheet, Virginia	19,210
Lancaster County sheet, Pennsylvania	2,000

Imperial Clay.—Soil is a heavy clay loam or clay, having a depth of 6 feet or more. Surface usually level, though in places small dunes are seen. Derived from deposition of finest sediment of the Colorado River. When dry and in its natural state it exists in hard cakes and lumps. After irrigation the soil dries very hard, and cracks intersect the surface in all directions. Difficult to till. Little under cultivation. Sorghum and millet produce good crops.

	Acres.
Imperial sheet, California	23,120

Jordan Clay.—Tenacious clay or clay loam 6 feet or more in depth. Level, low-lying plains, poorly drained, generally containing large quantities of alkali. Origin, lacustrine deposits. This soil has little present agricultural value, on account of poor drainage, general occurrence of alkali, and impervious nature of the material.

	Acres.
Salt Lake sheet, Utah	18,510

Neuse Clay.—Dark, tenacious, mottled gray clay, 3 feet or more in depth. Stream deposit, often subject to overflow, occurring along stream bottoms in coastal plain region of North Carolina. Poorly adapted to agricultural purposes on account of close, sticky nature and poor drainage, but when well drained it is good cotton land.

	Acres.
Craven sheet, North Carolina	14,930
Kinston sheet, North Carolina	2,010
Newbern sheet, North Carolina	8,170
Princeton sheet, North Carolina	1,030

Porters Red Clay.—Reddish-brown clay loam, 6 inches deep, underlaid by stiff, red, tenacious clay to depth of 20 inches or more. Both

soil and subsoil contain a large percentage of stone. Occupies mountain slopes. Residual soil derived from granite and other crystalline rocks. When not too stony and rough good soil for corn, wheat, grass, and apples.

	Acres.
Bedford County sheet, Virginia	28,240

San Jacinto Clay.—Drab to black clay, 4 to 6 inches deep, friable when well cultivated, but becoming waxy and sticky when wet, and if not continually cultivated caking into a very hard and compact mass that cracks into irregular blocks on drying. Subsoil a waxy, very stiff, and tenacious clay of same color as soil. Both soil and subsoil contain varying quantities of carbonate of lime concretions, ranging generally from 1 to 10 millimeters in diameter, but frequently larger. Pockets of quartz are also found, and pockets of the drab soil in the black, and vice versa. Type occurs on treeless prairies in Texas. Very fertile soil. Used commonly for corn and cotton; probably also adapted to grass.

	Acres.
Willis sheet, Texas	20,480

Sharkey Clay.—Yellow, waxy clay, 0 to 6 inches; yellow, waxy clay, 6 to 40 inches. Surface suncracks and resembles buckshot land. Forested area between stream courses in Yazoo River Delta, Mississippi. Subject to overflow. With diking and drainage would form valuable cotton soil. Very fertile.

	Acres.
Mayersville sheet, Mississippi	37,100
Yazoo sheet, Mississippi	97,280

Suffield Clay.—Clay loam, 12 inches deep, underlaid by close laminated clay. Lacustrine deposit. Very poorly drained. Level areas in Connecticut Valley. On account of poorly drained condition and close structure it is not adapted at present to any agricultural purposes, although used to some extent for pasturage.

	Acres.
Hartford sheet, Connecticut and Massachusetts	13,370

Susquehanna Clay.—Clay loam 6 inches in depth, containing gravel, overlying stiff, tenacious red or white pipe clay. Hills and rolling land on the western border of Coastal Plain region, Maryland and adjoining States. Clay is very refractory, hard to cultivate, and has at present little or no agricultural value.

	Acres.
Cecil County sheet, Maryland	11,000
Harford County sheet, Maryland	4,890
Prince George County sheet, Maryland	22,360

Yazoo Clay.—Heavy drab clay loam 0 to 5 inches; sun cracks to a state closely resembling "buckshot" land; drab clay 5 to 40 inches, usually underlaid by sand below 5 or 6 feet depth. Low areas to rear of front lands and higher ridges in open forest lands, Yazoo River

Delta, Mississippi. Needs draining. Cotton chief product; yield, about three-fourths of a bale.

	Acres.
Mayersville sheet, Mississippi	20,680
Yazoo sheet, Mississippi	24,400

ADOBE.

Fullerton Sandy Adobe.—Brown, sandy adobe to a depth of 5 feet; underlaid by compact sand or sandstone. Residual material derived from weathering of underlying shaly sandstone. Foothills extending down into level valley lands. Dry-farmed to wheat; when irrigated used to some extent for citrus fruits.

	Acres.
Santa Ana sheet, California	31,334
Ventura sheet, California	1,946

Salinas Gray Adobe.—Dark-gray adobe, grading in texture from sandy loam, containing considerable fine gravel, to silt loam. Occurs about edge of foothills and extends into the bottom lands. Thirty inches or more in depth, usually underlaid by a fine sandy loam and fine sand, occasionally by coarse sand and gravel. Seems to be derived largely from granitic material. Adapted to barley and other grains and sugar beets. A loose, friable, and excellent soil if irrigated, but refractory if allowed to bake. Generally free from alkali.

	Acres.
Salinas sheet, California	9,950
Soledad sheet, California	8,450

Salt River Adobe.—Clay loam with adobe properties, 2 feet deep, underlaid by sandy loam or loam. Low-lying land, containing alkali, and rather poorly drained. Sediment of prehistoric irrigation with muddy water. Generally adapted to alfalfa and small grain.

	Acres.
Salt River Valley sheet, Arizona	13,655

San Joaquin Black Adobe.—Heavy black or brown adobe soil 4 to 6 feet deep; subsoil varies from sandy adobe to heavy clay adobe or it may be decomposing shale. Margins of valleys along foothill streams in California, often extending out into the valleys. Derived from crystalline rocks or shale. Soil is difficult to till, but very productive. Adapted to grain crops, and used at present for citrus fruits where water supply is adequate.

	Acres.
Fresno sheet, California	5,664
Hanford sheet, California	5,470
Salinas sheet, California	11,580
San Gabriel sheet, California	23,650
Santa Ana sheet, California	16,038
Ventura sheet, California	4,290

San Joaquin Red Adobe.—Sticky red adobe, with texture of loam, 6 feet in depth; usually a layer of red sandstone hardpan in lower 3 feet.

Margins of plains adjacent to foothill streams; derived from foothill stream wash. Adapted to grain crops.

	Acres.
Fresno sheet, California	12,691

Sierra Adobe.—Sandy adobe containing small amounts of gravel to a depth of 2 or 3 feet, generally underlaid by red sandstone hardpan or granite rock. Low foothills. Residual soil derived from decomposition of underlying granite, used to some extent for dry farming to wheat and barley.

	Acres.
Fresno sheet, California	13,376

MEADOW.

Meadow.—When this term is unqualified it stands for low-lying, flat, usually poorly drained land along streams and embayments. Generally adapted to grass and pasturage, and occasionally used for general farming where artificially drained.

	Acres.
Alamance sheet, North Carolina	15,970
Allegan County sheet, Michigan	15,510
Bedford County sheet, Virginia	3,530
Calvert County sheet, Maryland	15,800
Cary sheet, North Carolina	3,180
Clayton sheet, North Carolina	2,730
Cobb County sheet, Georgia	30,280
Covington sheet, Georgia	16,410
Fresno sheet, California	5,478
Harford County sheet, Maryland	4,440
Kent County sheet, Maryland	49,230
Lancaster County sheet, Pennsylvania	6,000
Lebanon sheet, Pennsylvania	4,780
Montgomery County sheet, Ohio	7,200
Prince Edward sheet, Virginia	19,830
Prince George County sheet, Maryland	30,870
Princeton sheet, North Carolina	3,600
St. Mary County sheet, Maryland	54,200
Salem sheet, New Jersey	52,250
Sevier Valley sheet, Utah	10,200
Statesville sheet, North Carolina	18,850
Sunnyside sheet, Washington	5,100
Weber County sheet, Utah	7,700
Westfield sheet, New York	4,990
Willis sheet, Texas	1,510
Yakima sheet, Washington	9,960
Yazoo sheet, Mississippi	4,760

Connecticut Meadows.—Fine sandy or silty loam, 3 feet or more in depth. River-bottom soil, generally well drained, 15 or 20 feet above mean level of the river; subject to occasional overflow; found along Connecticut River. Glacial lake sediment reworked by river action. Recognized as fine land for corn, grass, potatoes, and like crops.

	Acres.
Hartford sheet, Connecticut and Massachusetts	19,620

Hondo Meadows.—Dark-colored clay loam or clay soil, occupying river bottoms or lowlands; subject to overflow. This soil generally contains alkali, and is poorly drained. Naturally adapted to pasturage, but when underdrained and protected from overflow it is adapted to alfalfa and grain.

	Acres.
Roswell sheet, New Mexico	7,940

Jordan Meadows.—Loam, 2 feet deep, clay to 4 feet, sand to 5 feet, underlaid by gravel. Low-lying wet land, usually containing alkali; occurring along Jordan River. Formerly this land was good for general agricultural purposes, but it is now generally abandoned, except for pasturage, on account of seepage from the bench lands and the accumulation of alkali.

	Acres.
Salt Lake sheet, Utah	6,840

MUCK AND SWAMP.

Connecticut Swamps.—Wet lands of various origin and texture, subject to continual overflow either from Connecticut River or high-lying streams and springs. Owing to poor drainage and presence of almost constantly standing water, soils have no agricultural value, except for occasional hay crops.

	Acres.
Hartford sheet, Connecticut and Massachusetts	14,470

Muck.—Vegetable mold more or less thoroughly decomposed and mixed with earth, occurring in low, damp places.

	Acres.
Allegan County sheet, Michigan	33,770
Craven sheet, North Carolina	20,860
Kinston sheet, North Carolina	5,430
Newbern sheet, North Carolina	1,740
Princeton sheet, North Carolina	800

Peat.—Vegetable matter consisting of roots and fibers, moss, etc., in various stages of decomposition; occurring as a kind of turf or bog, usually in low situations, always more or less saturated with water.

	Acres.
Santa Ana sheet, California	787

Pocoson.—Consists for the most part of a close, impervious, fine sandy gray or ash-colored soil lying on low ridges 3 to 6 feet above level of surrounding land, in the depressions between which the soil is darker colored, more spongy, and mucky in character. At a depth of 10 to 15 inches the soil grades into a sandy clay subsoil. Occupies swamp areas on low divides from 30 to 50 feet above sea level, with a flat surface, except for the slight ridges above referred to. Derived from the accumulation of organic matter in depressed areas under swamp conditions. Not subject to overflow, but under water for at least a part of the year. Generally in forest varying from a scrubby

to a heavy growth, beneath which there is a dense, practically impenetrable undergrowth of shrubs, vines, briers, and rank grasses. Areas vary much in fertility and need drainage, which is practicable. Better tracts are very fertile, and small areas cultivated grow excellent crops of corn and cotton. Occurs in Coastal Plain region, South Atlantic States.

	Acres.
Craven sheet, North Carolina	75,300
Kinston sheet, North Carolina	12,410
Newbern sheet, North Carolina	61,700

Savanna.—Soil consists of 3 to 9 inches of black, mucky soil, grading into a dark gray, fine sandy loam with silt, having the texture of the typical surface covering of Norfolk fine sandy loam. Below 6 to 12 inches occurs a subsoil of stiff, sticky yellow or mottled yellow clay. Found in broad, very level, and extended open areas in coastal plain, with an elevation ranging from 10 to 30 feet. It is a sedimentary soil. Because of attitude the drainage is very poor, and water stands on surface after rains. Very little savanna under cultivation. Yields fair crops of cotton, corn, and hay. Formerly used for upland rice. Natural growth scattered pine, sedge grass, saw palmetto, and cane.

	Acres.
Craven sheet, North Carolina	28,670
Newbern sheet, North Carolina	3,330

Swamp.—A condition of soils too wet for any crop. Generally with a heavy growth of water-loving grasses, herbs, or trees. Occurs in nearly all areas in the humid States.

	Areas.
Calvert County sheet, Maryland	3,600
St. Mary County sheet, Maryland	2,200

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